Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

OCTOBER, 1957

TECHNOLOGY DEPT.
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WIDE FLANGE BEAM AND STRUCTURAL MILLS

Designed and Built by MESTA

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MESTA Universal Structural Mill rolling wide flange beams on the 44" Universal Stand and the 34" Edging Stand at Inland Steel Company, Indiana Harbor Works

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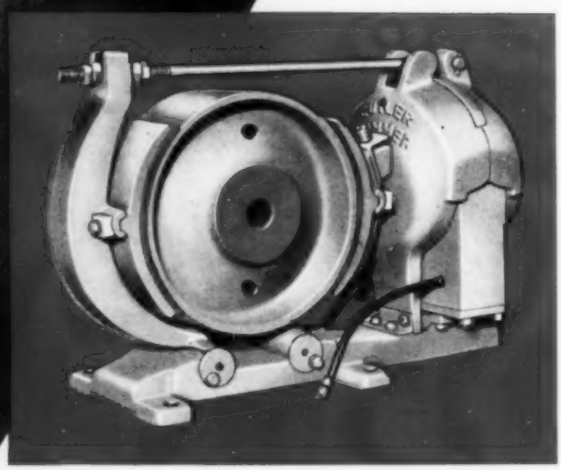
THERE IS NONE BETTER

Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

The Cutler-Hammer 505 Mill Brake can be adjusted perfectly in total darkness



Mill brakes are often installed in hard-to-reach places where there is very little light. Yet, as every mill man knows, they must be kept adjusted for lining wear. This is no problem when the brake is a Cutler-Hammer 505! It can be adjusted perfectly in total darkness.

A man doesn't need a flashlight . . . or a third hand to hold one . . . when adjusting a Cutler-Hammer 505 Brake. With one hand he turns the adjusting nut and with the other hand he simply *feels* the indicating pins. When these pins are flush with their housing, the brake shoes are in *perfect* adjustment. There are no scales to read, nothing to measure, no tedious testing or climbing up and down for readjustments.

Compare the Cutler-Hammer 505 Mill Brake with any others. The biggest users of magnetic brakes say the 505 has no equal . . . in design, in construction, and in performance. Compare and prove it. CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto.

Why Mill Men Prefer the Cutler-Hammer 505

Only ten major components; the ultimate in simplicity.

Over-the-wheel pull rod avoids clutter and trouble of complex linkage systems.

Single capsule operating coil easily accessible; reversible to put leads on either side.

Shoes can be adjusted perfectly in total darkness by simply feeling the positions of indicating pins.

Single torque spring means only one torque adjustment.

Nuts for all adjustments are above the center line of the motor shaft; nothing is buried or hard to reach.

CUTLER-HAMMER
MOTOR CONTROL
C-H

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developing new equipment ideas for the improved production of ferrous and non-ferrous...

PIPE • TUBES • BARS SHEET AND STRIP

some current ones you will be hearing about soon:

Mandrel-Type Uncoiler-Leveller for supplying skelp continuously to Continuous Butt Weld Pipe Mills.

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Pipe End Facing and Beveling Machine finishes ends of pipe automatically.

Coil handling device for placing coils in either horizontal or vertical position.

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Continuous annealing produces better strip faster through

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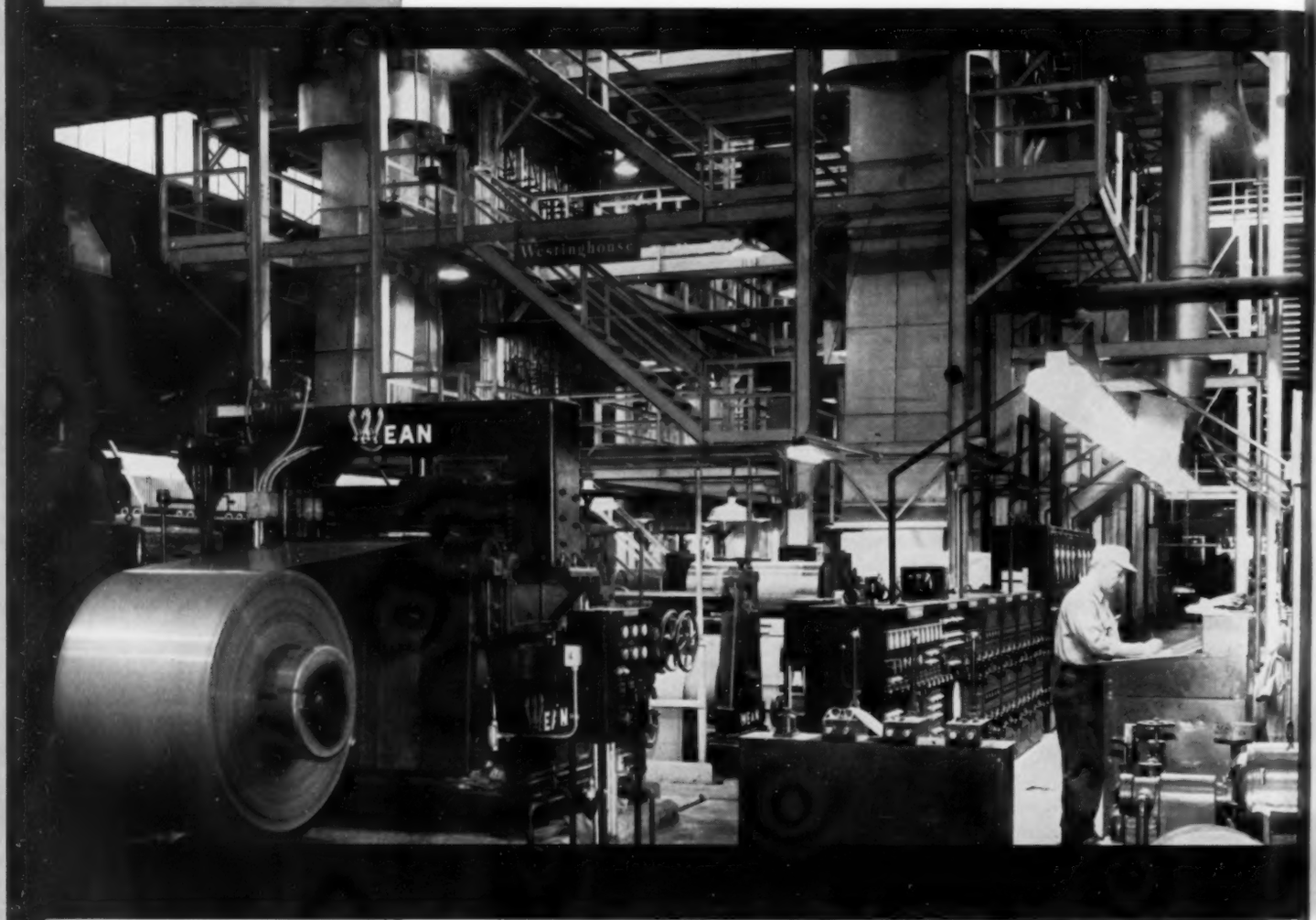

460

Moving at hundreds of feet a minute, silicon steel strip is annealed in this WEAN-Engineered continuous annealing line at U. S. Steel's Vandergrift plant. WEAN Creative Engineering provides better operating control and more uniform anneal at maximum speed for this type of operation.

WEAN has designed and built nine silicon and tinplate lines—eleven stainless steel lines . . . more than all other firms combined. Why not call on this vast experience in Creative Engineering to solve your annealing problems.

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Iron AND Steel ENGINEER

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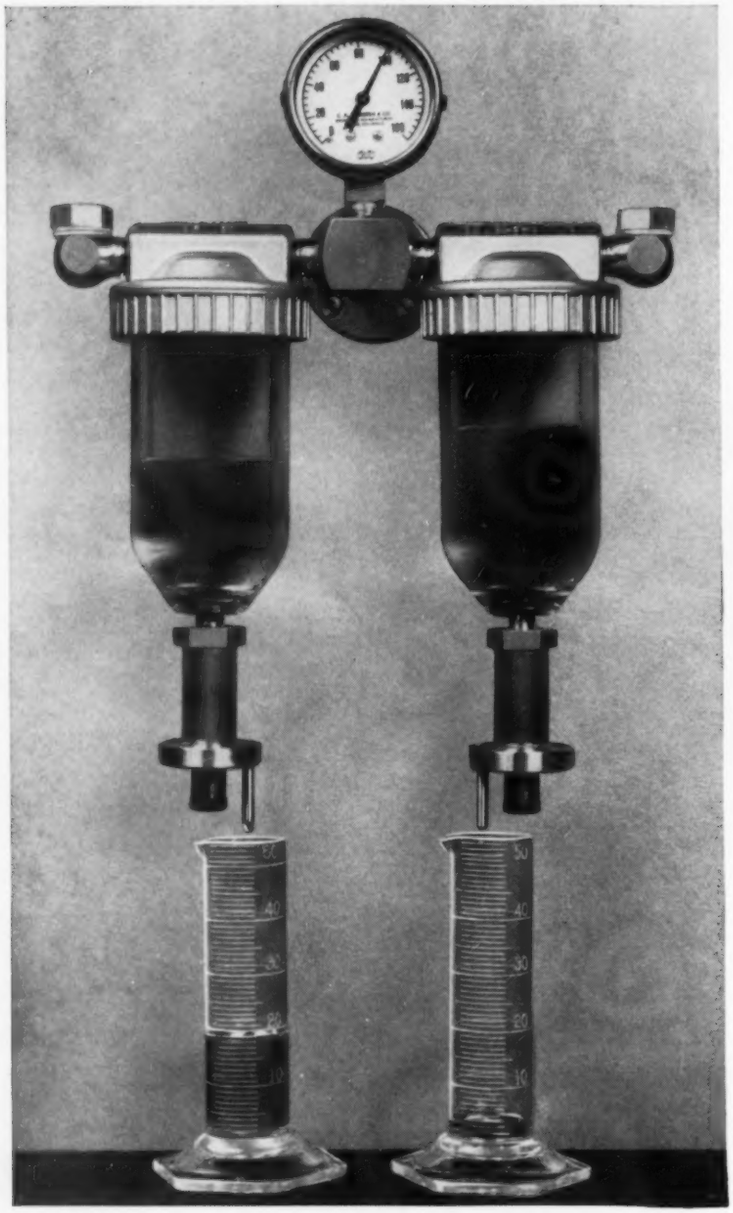

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Suntac oil in one chamber, your present hydraulic oil of the same viscosity in the other. Both oils are forced out through sintered bronze bearings. In this photograph, pressure of 100 psi caused a straight mineral oil to leak out four times faster than Suntac.

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See this demonstration in your plant

Take about five minutes at your own desk to learn how Suntac® oils stay put in hydraulic systems . . . reduce oil loss through loose joints and worn fittings.

Match Suntac against the hydraulic oil you're now using—see how the exceptional non-gummy antileak characteristics of Suntac can reduce your oil losses as much as 75%. *Some users have even reported savings of 90%.*

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Have him arrange with a Sun Lubrication Engineer to give you and your staff a private demonstration. For further information on the uses of Suntac in hydraulic systems and in general lubrication, write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. IS-10.

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INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY PHILADELPHIA 3, PA.

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IN CANADA: SUN OIL COMPANY LIMITED, TORONTO AND MONTREAL

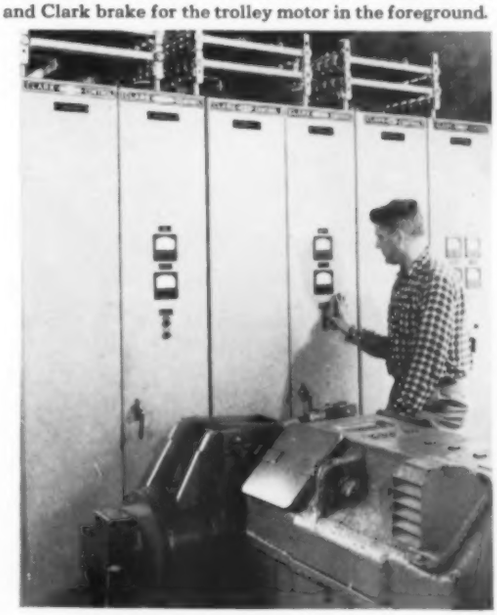
ONE MAN and CLARK CONTROL operate this giant unloader with capacity of 1100 tons per hr.

An average of 10,000 tons of coal per day is unloaded from river barges at the Ohio Valley Electric Corporation's Kyger Creek power plant, by two Heyl-Patterson rope-trolley unloaders. This plant and another like it at Clifty Creek are the largest privately-owned generating stations in the world—combined capacity 2,365,000 kw—supplying a total of 17 billion kilowatt hours per year for an Ohio atomic energy project.

Clark adjustable voltage control systems with magnetic amplifiers, team with Elliott rotating equipment in each unloader to provide maximum unloading rate, smooth acceleration and stopping, high efficiency, low maintenance and long rope life. One man controls the entire operation.

This is another example of greater operating efficiency through Clark-engineered Control. Let us help solve your control problems.

Clark control including magnetic amplifiers, located in motor room atop the tower, provides adjustable voltage control with current limit acceleration, deceleration and dynamic braking for the three drive motors. Note Clark edgewound resistors on top of the cabinet and Clark brake for the trolley motor in the foreground.



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put physical and thermal properties *in proper balance!*

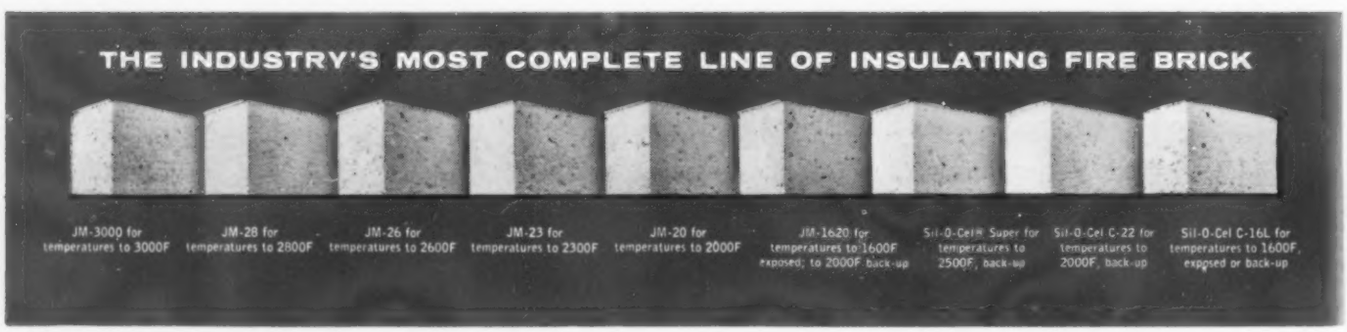
...provide essential high-temperature resistance and low conductivity...yet maintain high load-bearing strength with low spalling!

Only Johns-Manville's insulating fire brick family offers the right combination of properties to meet the diversified requirements of modern furnace construction.

Johns-Manville's nine different insulating fire brick mean you never have to settle for a brick that's nearly right! Instead you choose the one insulating fire brick or combination of brick that best meets your specific requirements for temperature resistance, load-bearing strength, conductivity and density.

Johns-Manville has two strategically located plants for the production of insulating fire brick: Lompoc, California and Zelienople, Pennsylvania. Insulating fire brick and other Refractory Products are available from the stocks of Authorized J-M distributors in key industrial areas.

For further information, call your nearest J-M representative. Or write for brochure IN-115A to Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.


THE INDUSTRY'S MOST COMPLETE LINE OF INSULATING FIRE BRICK
JM-3000 for temperatures to 3000F
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Johns-Manville REFRACTORY and

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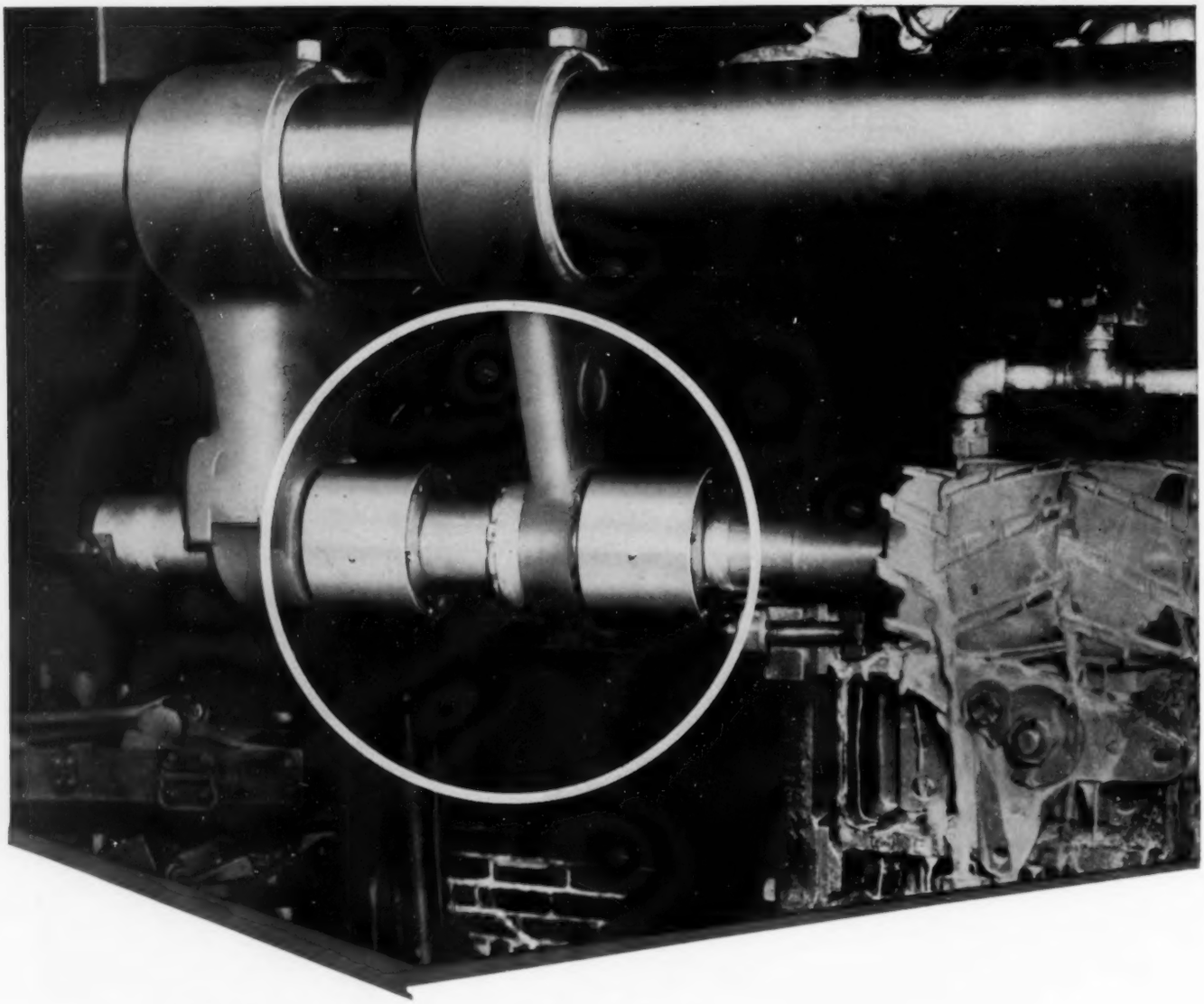

Bearings, Inc.

helps milling machine operators cut tool and maintenance costs – improve accuracy!

By replacing the usual bronze split-tapered bushing found on the outer support arm of most milling machines with the new Jergens Milling Machine Anti-Friction Bearing – many benefits are immediately apparent! At a large Central Ohio manufacturing company greater arbor rigidity, elimination of twisted arbors, frozen bushings and chatter was reported.

Maintenance costs are reduced $25 per machine, per month, according to our customer. Cutter breakage is no longer a problem and the milling machine operator is able to hold closer tolerances, it was reported.

This is only one of many bearing products, designed to improve performance and reduce costs, that we are authorized to distribute. For complete information and expert knowledge of all bearing applications call the branch nearest you today!

Providing bearing service in the territories adjacent to our branches, listed below.

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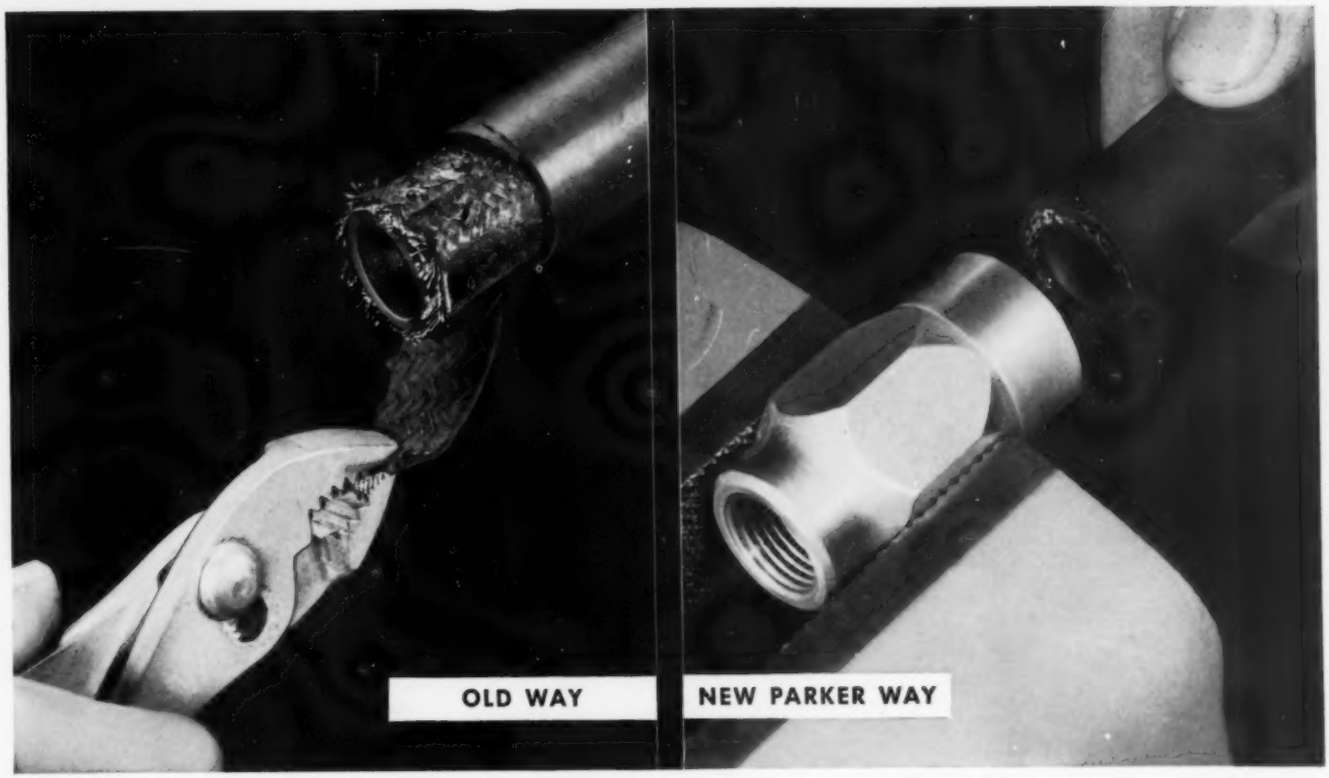


New Parker No-Skive Hoze-lok

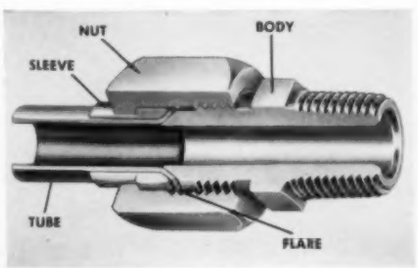
FASTER . . . EASIER . . . RE-USABLE

No more frustrating jobs of stripping off the covers of hydraulic wire-braid, rubber-covered hose! No more ragged hose ends that refuse to enter fitting sockets!

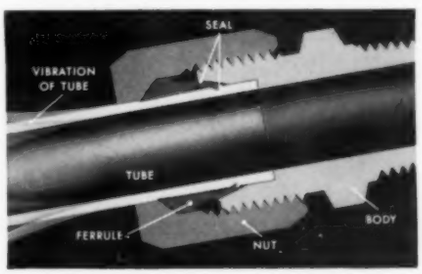
New Parker Hoze-lok Fittings save you all this time and trouble. Skiving of hose covers is *not* necessary. Simply screw the hose (with cover intact) into the socket and then screw the nipple in to complete the make-up. What could be easier . . . or more effective?

Versatile Hoze-lok Fittings are re-usable . . . an important benefit to users of your equipment. Select your fittings from the new series of Hoze-lok styles and sizes, with four different connecting ends and full range of adapters.

Ask your Parker Distributor or mail this coupon today for catalog about Parker Hoze-lok Fittings and for details about Parker Triple-lok and Ferulok.



Triple-lok Flare Fittings . . . the easiest, fastest, safest way to tube up even in close quarters. Leakproof even under severe vibration, high pressures. Meet S.A.E. Hydraulic Tube Fittings Standard.



Ferulok Flareless Fittings for high-pressure, heavy-wall tubing. Double seal makes Ferulok leakproof, vibration-proof. You can see the "bite." Meet S.A.E. Hydraulic Flareless Tube Fittings Standard.

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- ☐ *Hoze-lok* Catalogs 4433, 4434
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Hydraulic and fluid system components

CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

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WICKLIFFE, OHIO

Crops *and* Shorts

THE 1957 convention of the Association of Iron and Steel Engineers, celebrating the organization's 50th anniversary, turned out an attendance of more than 3300 individuals—a record for this type of affair. Technical sessions attracted high interest and fine crowds. The dinner on Wednesday night was set for 1634 people—again, a new high which taxed available space in Pittsburgh's Penn-Sheraton Hotel.

An interesting point was the attendance of James Farrington, of Steubenville, Ohio, and Fred Woodhull, of Coatesville, Pa., the two remaining charter members of the original group of 28 who founded the Association.

▲

ACCORDING to the American Iron and Steel Institute, the new center of steelmaking capacity of the United States is at Westminster, about eight miles southeast of Lima in Allen County, Ohio. This is 17 miles southwest of the 1951 center at Mt. Cory, Ohio.

The 1957 center of the nation's blast furnace capacity is located at LaRue, which is approximately 13 miles west of Marion, Ohio. Shelby, Ohio, about 12 miles northwest of Mansfield, is the center of hot rolled sheet and strip capacity.

▲

THE shorter work week is an item that is bound to become a matter of bargaining in the next few years. On the surface, motives for seeking shorter hours are said to be more leisure time and avoidance of mass unemployment.

We have found no workers who are particularly anxious for more leisure time. In fact, a great many have taken on second jobs to increase their income, working even seven days a week.

Mass unemployment worries stem from that monstrous word, "automation," which many mistakenly think is something new and therefore something to be feared. In the 1920's, technology was the bugaboo, but we have full employment today.

Actually, the prime concern is probably higher take-home pay arising from the necessity of overtime pay to keep production volume in step with our requirements.

The shorter work week, by raising labor costs, would actually increase the pressure for automation to offset this increase. It would probably attract more women into the labor force and keep older workers in the force. It would doubtless free more people for second jobs or it would set up a need for more income for good use of the added leisure time (and we're not so sure the wives would appreciate having their husbands hanging around the house any more).

If pay for a 36-hour week were the same as that for 40 hours, payroll would increase 11 per cent. If work time remained at 40 hours, with overtime rates above 36 hours, payroll would go up 17 per cent. Such increases would be bound to drive prices higher—more fuel to feed the flames of inflation.

And, of course, working days may become so short there'd be no time for a coffee break.

▲

OUR neighbor says he had the best vacation of his life. His self-winding watch ran down.

▲

A CORRESPONDENT in England says that the period of steel shortages is passing but during a conference several years ago, a speaker was asked what acceptance tests he used for steel sheet at his works.

"When we receive a batch," he replied, "we cut a corner of one sheet and put it in a bucket of water. If it floats we reject the lot!"

▲

AND from Canada comes a report of an Ontario service station offering expert handwriting analysis to all visitors on the station's opening day, with the result that many visitors became regular customers.

Probably helped the station's credit man, too.

▲

JUST to let us know there's really nothing new under the sun, a Pittsburgh friend quotes from "Plan for Steel" in the Journal of the Iron and Steel Trades Confederation for August 1957: "The Iron and Steel Board's special report on the future development of the iron and steel industry opens with a somewhat light-hearted reference to what was probably the first survey of the industry ever made, when, in 1574, the Privy Council required the ironmasters to attend at Hampton Court on pain of 2000 pounds to report on their activities, which apparently were not, in the Privy Council's view, above suspicion."

▲

TYPICAL of the times is the campaign by the AFL-CIO Boot Workers Union to force shoe manufacturers to raise prices. Claiming that shoe prices have dropped three per cent in 1947–56 while all commodities have increased 42 per cent, the union says: "An industry that attempts to function with depressed prices and profits is a drag on the market."

▲

THE chap next door sourly observes that women can never be as successful as men—they have no wives to advise them.

▲

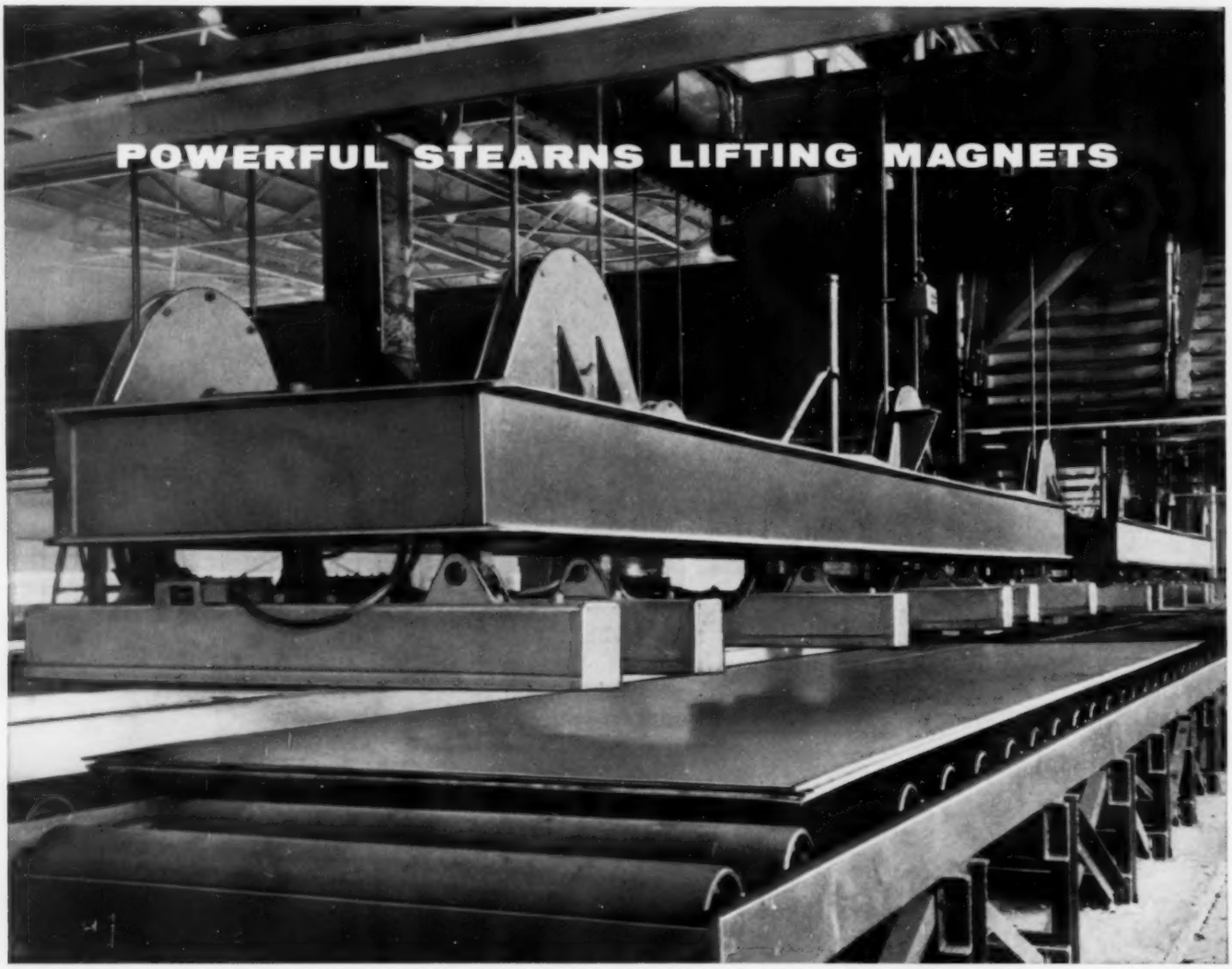
A NEW kind of silicon iron has been developed, said to be doubly-oriented and easily magnetized in four directions, promises increased efficiency in transformers, motors and generators.

▲

DR. Alfred P. Haake told the AISE Birmingham district section that there's usually one less great man than you think there is.

▲

THE jet age is going to bring some drawbacks. The planes will be so fast you won't have time to get acquainted with the hostess.



Heavy sheets in a large eastern steel mill leap up from conveyor rolls as powerful Stearns deep-field magnets come down for a lift. Six-magnet assembly on huge hoist frame can handle any lift, place it where it's needed swiftly, safely, accurately.

put JUMP into heavy steel-handling jobs

Handling transfer of heavy sheets and billets... quickly moving plates, bars, ingots, pipe . . . lifting crated iron and steel goods — Stearns rectangular lifting magnets are paying their way in large and small mills and foundries everywhere.

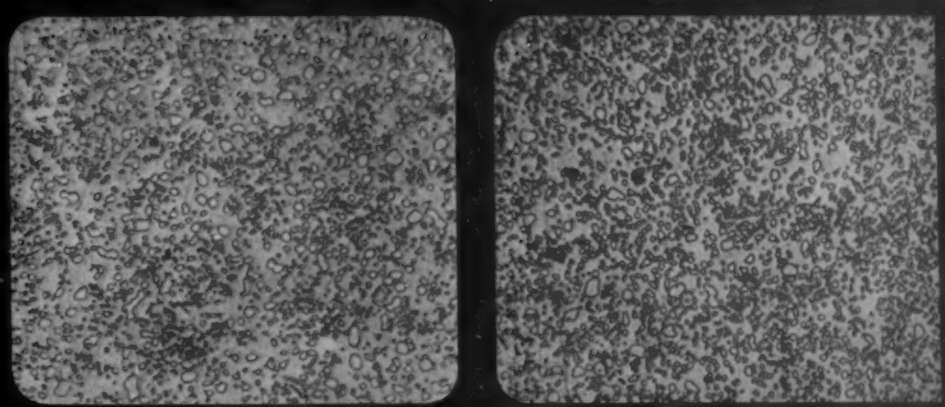
Stearns lifting magnets are quality-built for years of trouble-free service. Heavy-duty construction and rugged insulation assure dependable performance hour after hour on the toughest material handling jobs. You get more out of these units because Stearns puts more into them.

Stearns builds both rectangular and circular lifting magnets for practically any application, with capacities to match your requirements. Call your Stearns representative . . . or write for free literature. Ask for Bulletin 35-CI. 53

STEARNS MAGNETIC PRODUCTS

635 SOUTH 28TH STREET • MILWAUKEE 46, WISCONSIN

HERE'S Spheroidizing AT ITS FINEST...



Core structures of spheroidized rod, magnified 1000 times.

SPHEROIDIZING PROCESS MADE EASY WITH LEE WILSON HIGH CONVECTION FURNACES

Nothing rolls like a ball — this applies to bearings as well as the grain structure of steel which is to be formed cold into bolts, auto bumpers, lock washers or razor blades.

To get this spheroidal structure in steel, the metal must be uniformly heated, but in no part overheated, and, after all parts of the charge are at the temperature required, it must be uniformly cooled at controlled rates so that the iron-carbon grains will have the shape of a ball as they form.

This heat treatment of steel has enabled fabricators to eliminate slow and expensive hot forming processes and to cold form a multiplicity of items at almost unbelievable speeds.

The Lee Wilson High Convection Bell Type Annealing Furnace with uniform heat application, specialized cycle control, and gas circulation up to 25,000 cfm. under a sealed inner cover, was designed specifically to meet all the requirements for uniformity and closeness of control demanded by this process.

123

Lee Wilson* ENGINEERING COMPANY, INC.
20005 WEST LAKE ROAD • CLEVELAND 16, OHIO

HIGH CONVECTION ANNEALING FURNACES
MAKE THE BEST METALS BETTER

*ORIGINATORS AND LEADING PRODUCERS OF HIGH CONVECTION ANNEALING FURNACES

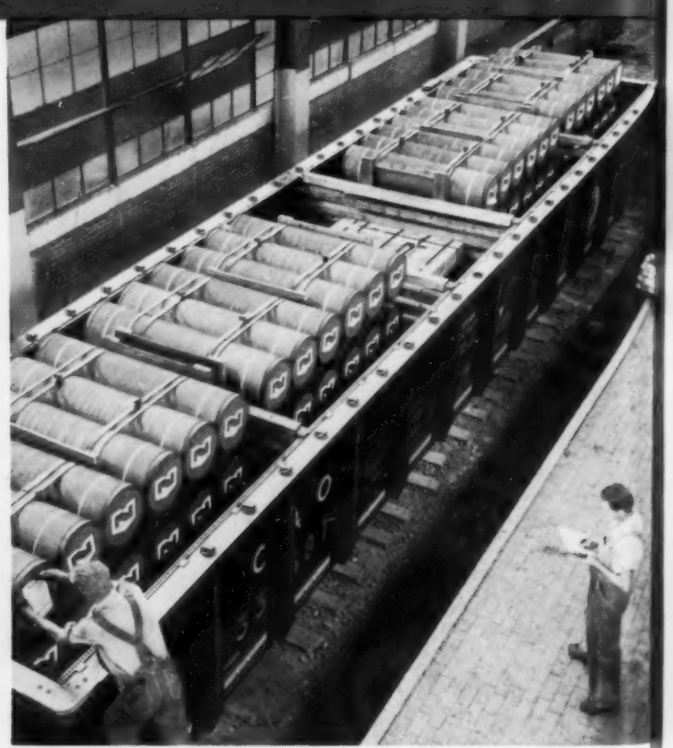
one more reason to specify

NATIONAL ELECTRODES
TRADE MARK

IMPORTANT NEW SAVINGS for ELECTRIC FURNACE OPERATORS

PIONEERED BY NATIONAL CARBON COMPANY

Seven ¼" steel rails run length of car sides. Cross-members of 9-gauge steel, wood-faced to prevent gouging, fit into 1" center rail holes to give each compartment a restraining force of 42,000 lbs.



A full load of 18" graphite electrodes and nipples in a Chesapeake & Ohio damage-free gondola car. The car can be unloaded quickly and simply from either end.

Twenty seven 35" x 110" electrodes loaded in a new Union Pacific damage-free gondola car.
Previous gondola car design permitted a maximum load of only fifteen electrodes of this size.

Now, in addition to assuring safe electrode shipments, you can simplify unloading, avoid demurrage and greatly reduce dunnage disposal problems. The reason: new damage-free gondola cars developed jointly by National Carbon Company and the Evans Products Company.

Thanks to an ingenious system of adjustable bracing, these "DF"† gondola cars require minimum dunnage yet carry substantially greater loads than ordinary gondola cars. Unloading from either end of the car is quick and simple. Since cars are not tied up long and average shipments are larger, furnace operators save penalty fees and cut handling costs.

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NATIONAL CARBON gives furnace operators . . .

* **Highest uniform electrode quality**
* **National service organization**
* **Technical electrode program for operators**
* **Scientific packaging to assure damage-free delivery . . . to keep electrodes clean . . . to eliminate in-plant handling damage.**

†"DF" is a trade-mark of Evans Products Company.

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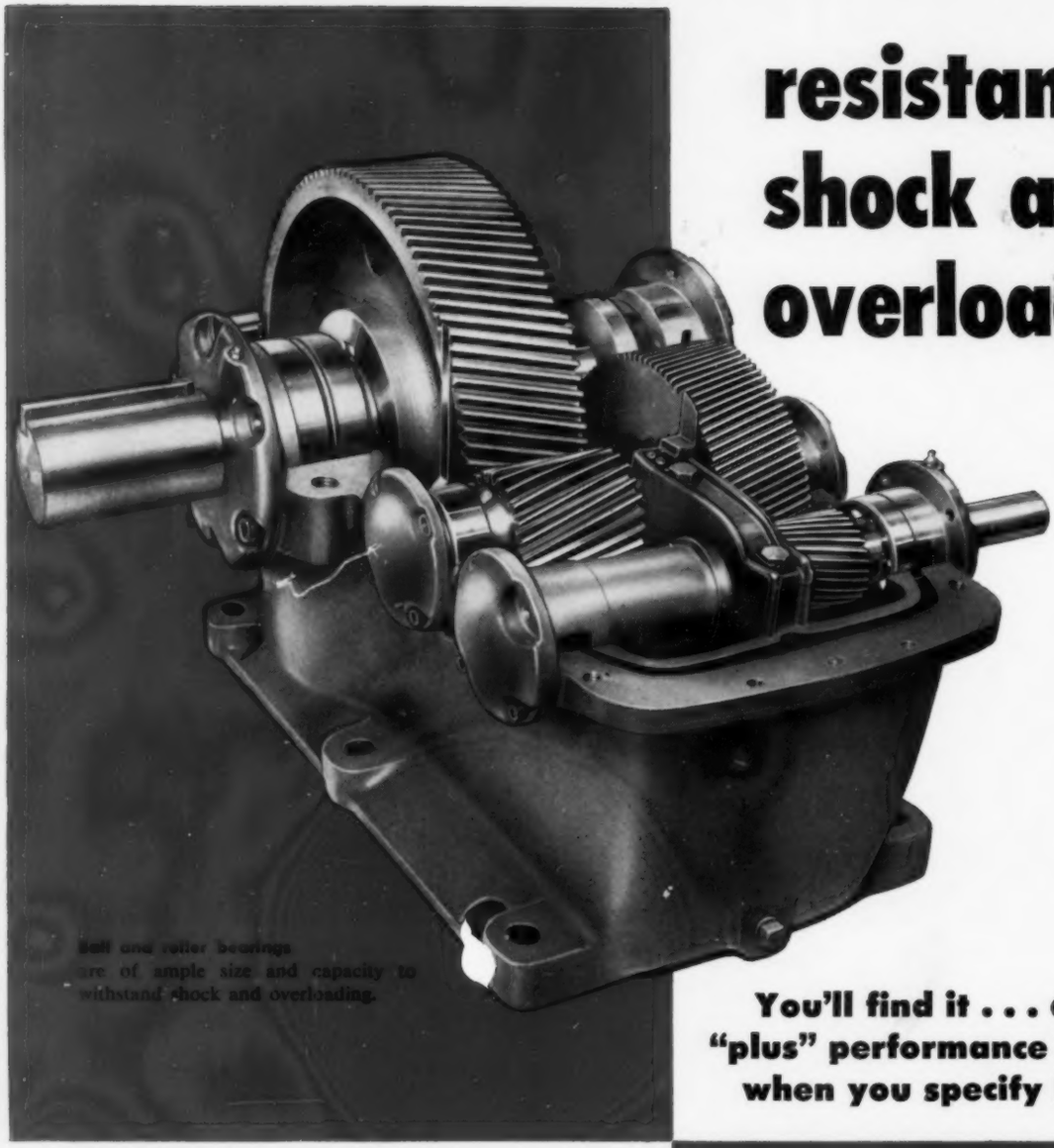

Ball and roller bearings are of ample size and capacity to withstand shock and overloading.

resistance to shock and overloading

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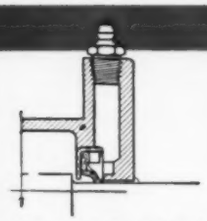
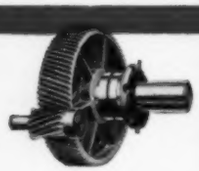
Under the shocks and overloads that are often encountered by parallel shaft gear drives, rugged housing construction is vital if shaft alignment is to be maintained. That's why Link-Belt adds special reinforcement at points of greatest stress . . . has developed this design expressly for endurance in heavy-duty service.

Write for your copy of Book 2619 on this broad line with ratios to more than 300:1. Or get first-hand information from your nearest Link-Belt office or authorized stock-carrying distributor.

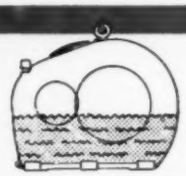
Sturdy housing of heavy gray iron provides rigid support of shafts.



Grease-lubricated seals on all input and output shafts prevent entrance of dirt, water.



Precision gears and shafts provide high reduction ratios in small space.



Automatic splash lubrication reliably supplies oil to all gears and bearings.

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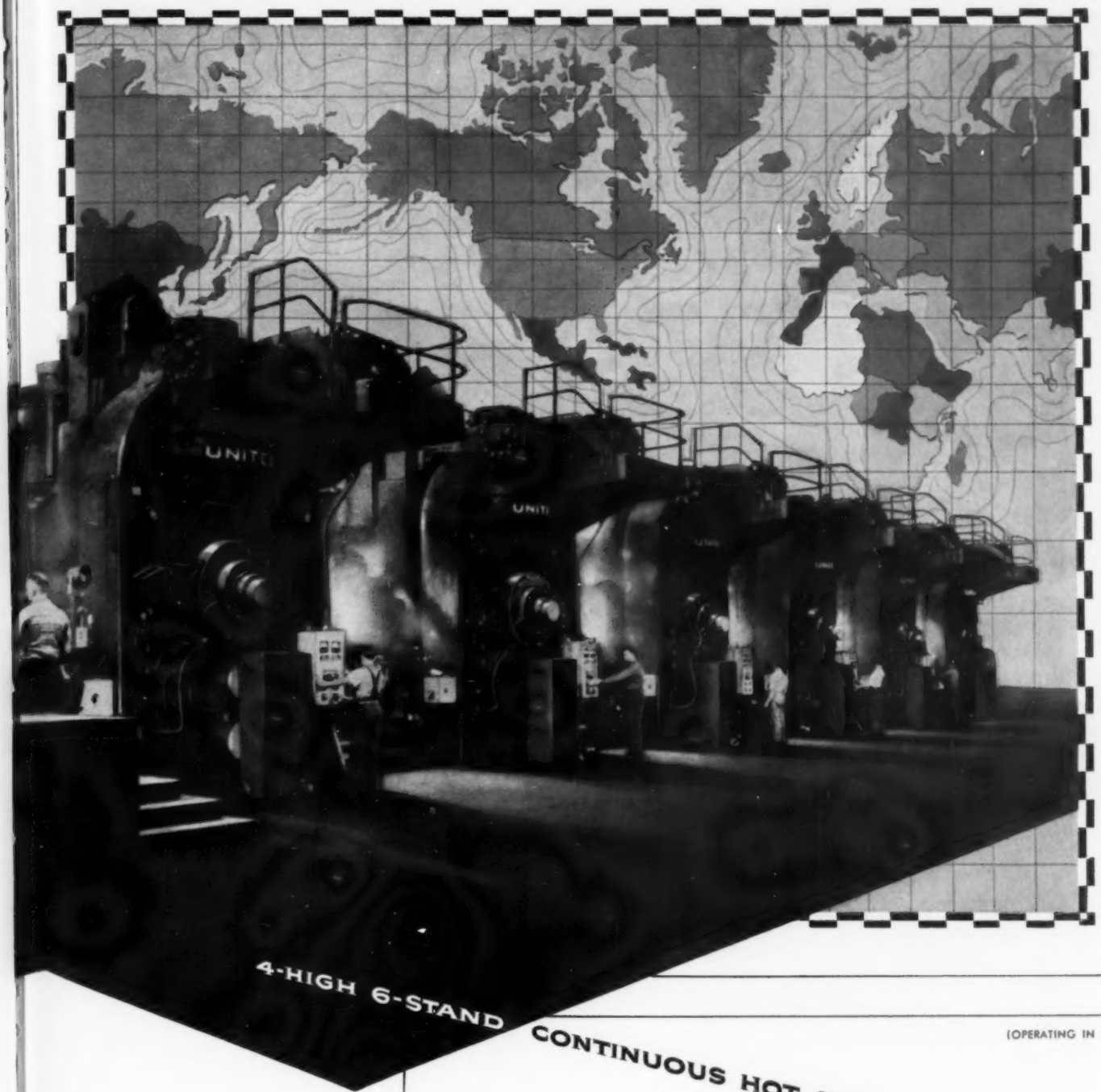

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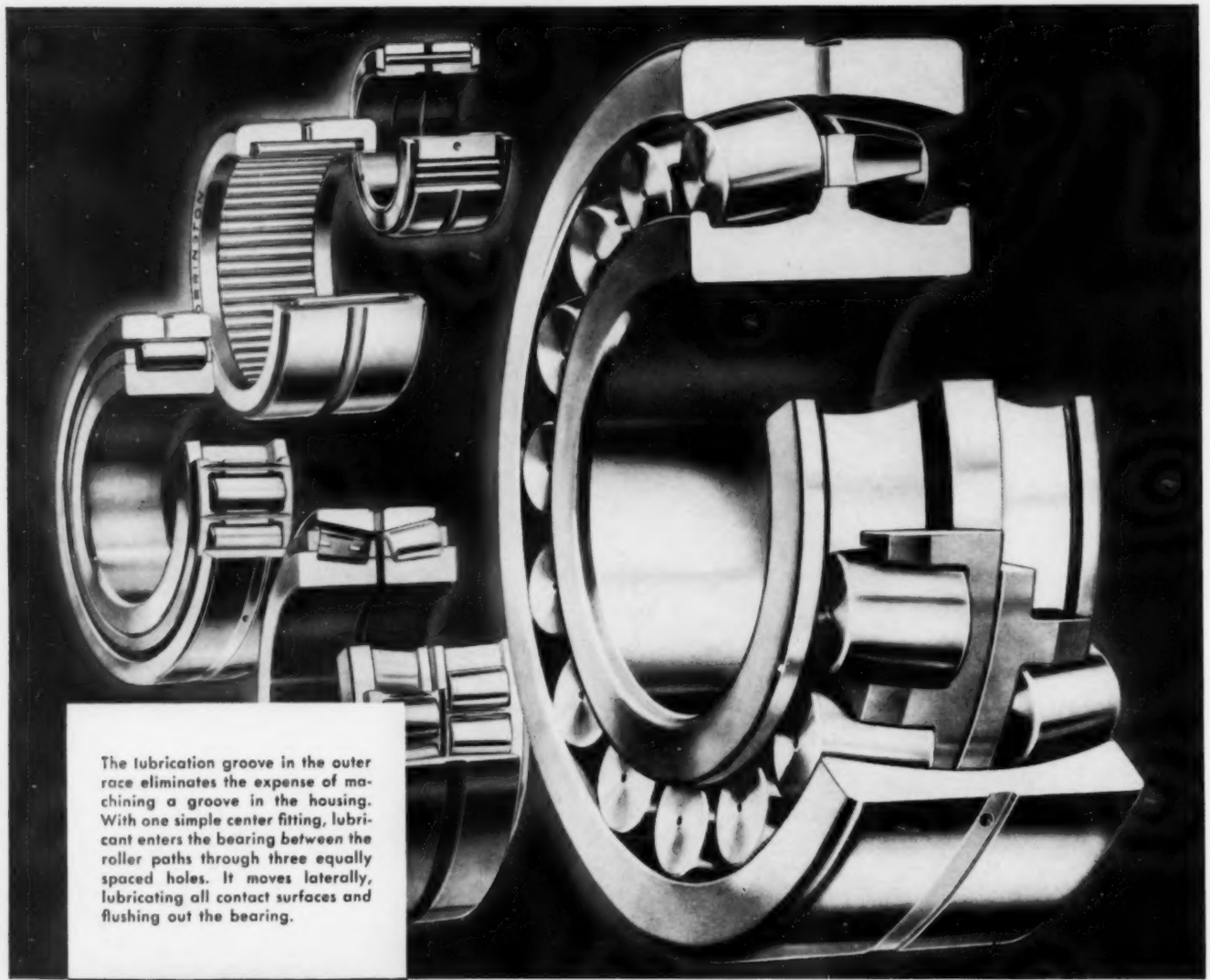
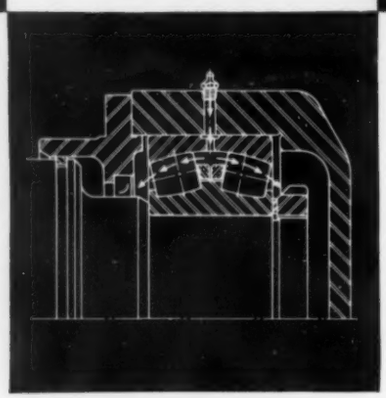


The lubrication groove in the outer race eliminates the expense of machining a groove in the housing. With one simple center fitting, lubricant enters the bearing between the roller paths through three equally spaced holes. It moves laterally, lubricating all contact surfaces and flushing out the bearing.



A time-proved lubricating method now available on Torrington Spherical Roller Bearings

The circumferential groove in the outer race has met the test of experience in many Torrington Bearings, including Heavy Duty Needle Bearings, Aircraft Type Needle Bearings, Tapered and Radial Roller Bearings. Now the circumferential lubrication groove is available in Torrington Spherical Roller Bearings.

This design feature makes it possible to introduce lubricant *between* the roller paths without the expense of machining a groove in the housing. This groove is proportioned to provide generous lubricant flow capacity. Lubricant moves through the roller paths, flushing used lubricant and contaminants away from bearing contact surfaces.

Torrington Spherical Roller Bearings in many sizes may be ordered with this groove as desired at no additional cost. For further information, see your Torrington representative or write: **The Torrington Company, South Bend 21, Ind.—and Torrington, Conn.**

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METALKASE XXP and XP

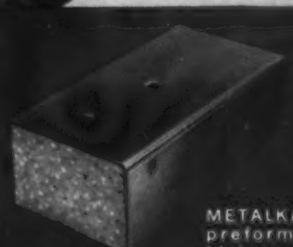
Steel Encased and Internally Plated Basic Brick Provide

- **greater spalling resistance**
- **reduced peeling tendency**

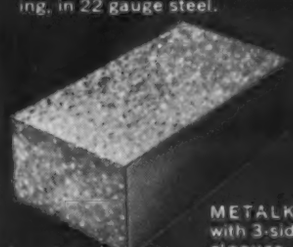
METALKASE XXP are chemically bonded basic brick with two internal plates, formed under high pressure, and are furnished in standard sizes, suspended arch and other shapes. They are available in various compositions. In the illustration the METALKASE XXP brick is cut to show the plated construction. These plates extend through the length of the brick.

METALKASE XP brick, having a single internal plate, are made in hard fired basic brick of various classes. They are available in standard sizes and many special shapes. These brick are used in various particular applications with great benefit.

Extensive use in service clearly demonstrates the superior spalling resistance of the internally plated brick, and as the result of improved stress relief, appreciably reduced tendency to peel.



METALKASE brick, preformed under high pressure and encased on all four contact sides by welding, in 22 gauge steel.



METALKASE brick with 3-sided steel enclosure, especially suited for electric furnace side walls and other specific applications.

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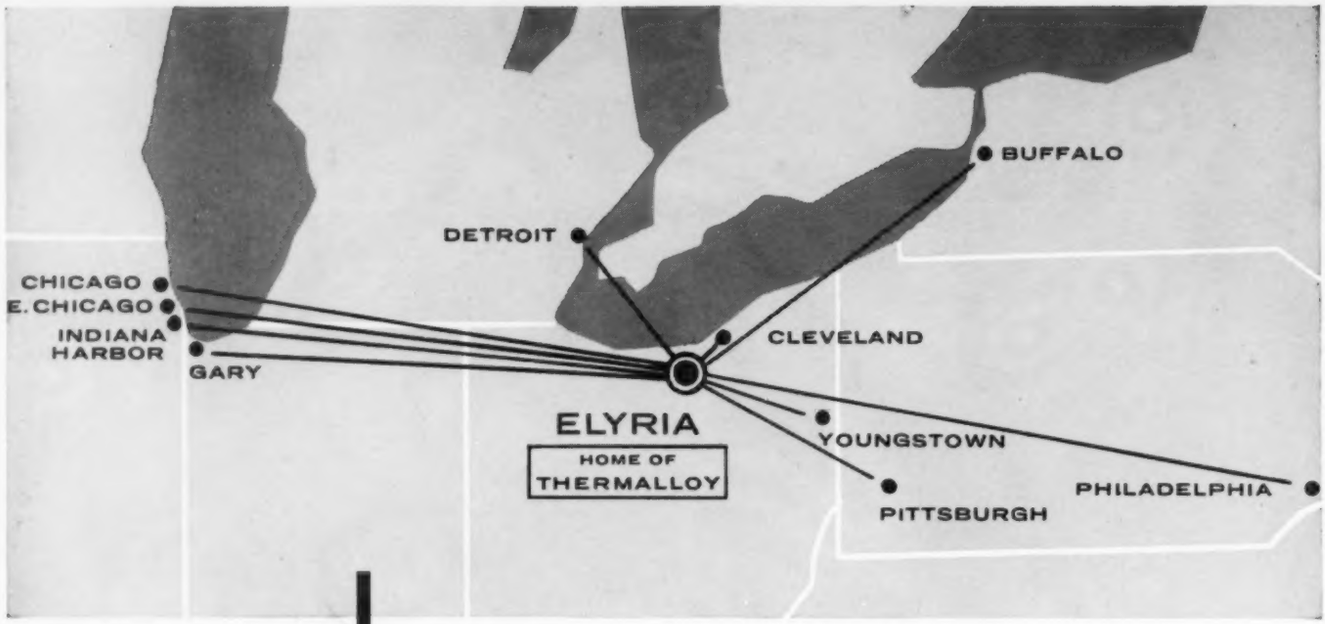

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If you can't visit us, call our nearest sales representative. He'll put our expanded facilities to work for you on any high-heat-resistant casting requirement you may have, such as the parts shown below. Electro-Alloys Division, 80610 Taylor St., Elyria, Ohio.

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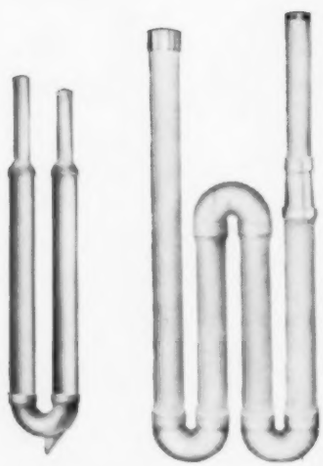

Thermalloy Radiant Tubes Centrifugally cast, X-ray controlled, pressure-tested.

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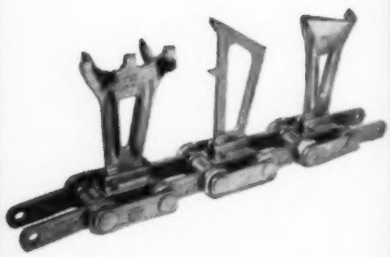


Thermalloy Carrier Blades and Chain ...Three types of blades, mounted on *Thermalloy* conveyor chain.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION Elyria, Ohio

Patent Reviews

....copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., at 25 cents....patents reviewed cover period April 30, 1957 through May 21, 1957....

by
MELVIN NORD
Patent Attorney,
Detroit, Mich.

REMOVAL OF SCALE FROM METAL STRIP

▲ U. S. 2,790,229, issued April 30, 1957 to Axel S. Hellstrom, assigned to The Youngstown Foundry & Machine Co., describes a process for treating metal strip to remove scale.

Apparatus is provided for applying substantial longitudinal tension to the metal strip being processed and simultaneously working it over a number of working rolls to flex the metal to the limits of its elasticity and remove the scale from it. This combination of tensioning or limited stretching of the metal plus the cold working has been found to process the metal successfully with respect to the removal of scale from it and elimination of transverse shadow marks.

LIQUID-JET DESCALER FOR FORGING BLANKS

▲ U. S. 2,790,230, issued April 30, 1957 to Alfred S. Sobek, assigned to Loftus Engineering Corp., describes apparatus for producing high-velocity liquid jets for removing the scale formed on forging blanks during their heating.

The invention primarily concerns the liquid-circulating system, including pumps and automatic means for operating a valve controlling the liquid flow. The use of large accumulator chambers for building up a quantity of liquid under the desired pressure has been eliminated.

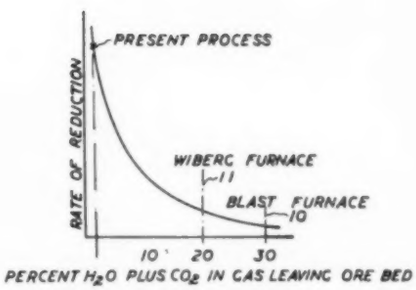


Figure 1

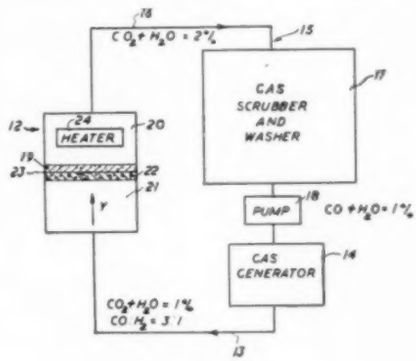


Figure 2

REDUCTION OF IRON ORE

▲ U. S. 2,790,710, issued April 30, 1957 to Patrick E. Cavanagh, assigned to Ontario Research Foundation, provides a continuous method of permeable support reduction for forming metal powders from reducible materials.

Figure 1 is a curve indicating reduction of iron ore at 2000 F, showing in what manner the rate of reduction is affected by the percentage of reaction products in the gas leaving the gas exit surface of the ore during reduction, and Figure 2 is a flowsheet of the process described in the patent.

The object of the invention is to speed up the reduction process by contacting the iron oxide with reducing gas having the least possible percentage of reaction products. Figure 1 shows the relative rates of reduction in a blast furnace, in a Wiberg furnace for producing sponge iron, and in the present process, the improvement being readily apparent.

A reducing zone of chamber 12, isolated from atmospheric gases, has reducing gas injected into it from a line 13 leading from a gas generator. The reducing gas circuit shown is of the regenerative type, in which gases from the chamber 12 proceed by line 16 to a gas scrubber and washer device 11, which removes CO_2 and H_2O. A pump 18 ensures sufficient gas volume delivery through the reducing chamber 12.

The reducing gas accumulates only 1 per cent in reaction products in passing through the reducing chamber. A relatively shallow bed of reducible material 19 is supported in the reducing chamber in order to minimize gas utilization per unit gas volume during passage through the chamber.

The ore bed 19 rests on a permeable support 22. The ore bed is heated from above, for example by electric resistance heating elements

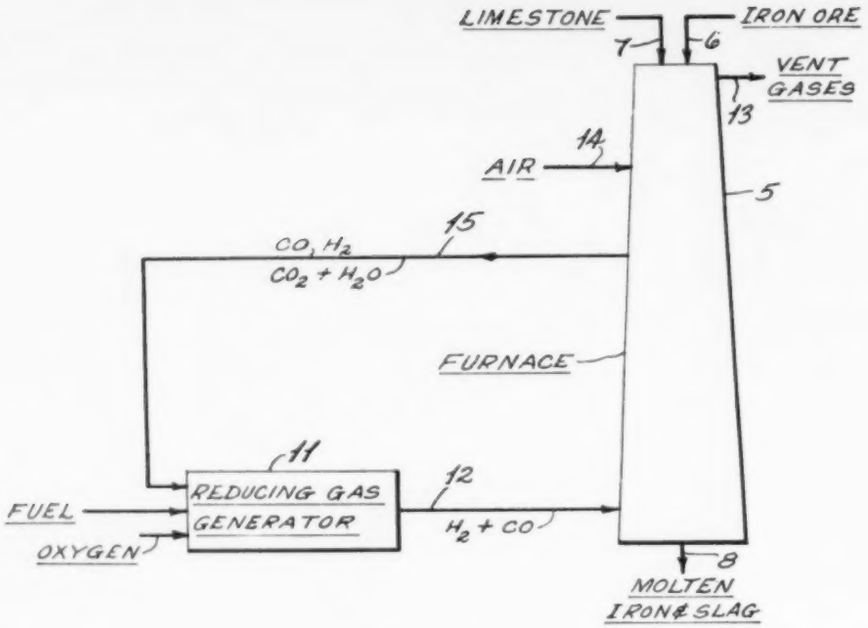


Figure 3

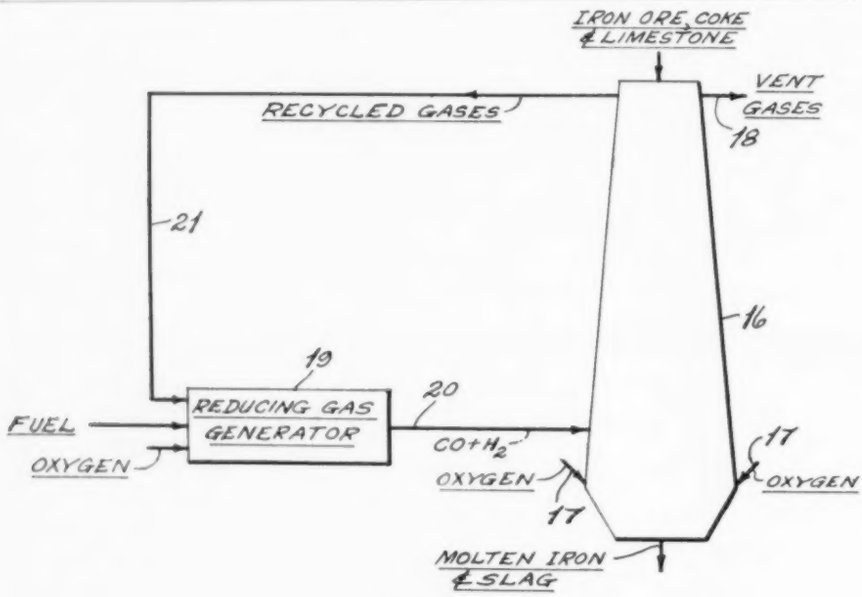


Figure 4

or a gas flame. Thus, particles at the exit surface of the bed will be at a higher temperature, which will offset the tendency toward decreased reduction rate caused by the increase in concentration of reaction products. Thus, a uniformity of reduction is accomplished.

REDUCTION OF IRON ORE WITH CARBON MONOXIDE AND HYDROGEN

▲ U. S. 2,790,711, issued April 30, 1957 to Frederick B. Sellers and Peter L. Paull, assigned to Texaco Development Corp., describes a process for the production of metallic iron or pig iron by the reduction of iron ore in lump form with carbon monoxide and hydrogen. The use of coke is partially or entirely eliminated, depending on the conditions of operation.

As shown in Figure 3, the numeral 5 designates a shaft filled with iron ore in which the ore is reduced to the molten metal. Iron ore and limestone are introduced as charge to the upper end of the shaft, at 6 and 7. Molten iron and slag are tapped off the bottom of the shaft, at 8. Reducing gas is generated in a gas generator 11, in which fuel and oxygen are combined to produce a mixture of carbon monoxide and hydrogen, which is passed at about 2600 F to the lower portion of the shaft.

In the lower portion of the furnace, the iron oxide is reduced to metallic iron. The CO is oxidized to CO_2 by the ore, and the hydrogen to water. Hot gases vented from the top of the furnace, at 13, are used to generate steam. Air or oxygen is introduced into the upper portion of the furnace, at 14, to burn the unreacted carbon monoxide and hydrogen. This preheats the incoming charge of iron ore and limestone. As much as 70 per cent of the gas is recirculated from an intermediate point, 15, back to the gas generator.

Sulphur may be removed from the reducing gas before it is introduced into the shaft, by passing it through a bed of limestone. The limestone may subsequently be charged to the shaft with the ore, as the sulphur will be removed from it by burning with air or oxygen at 14.

Figure 4 shows the application of the process to a blast furnace.

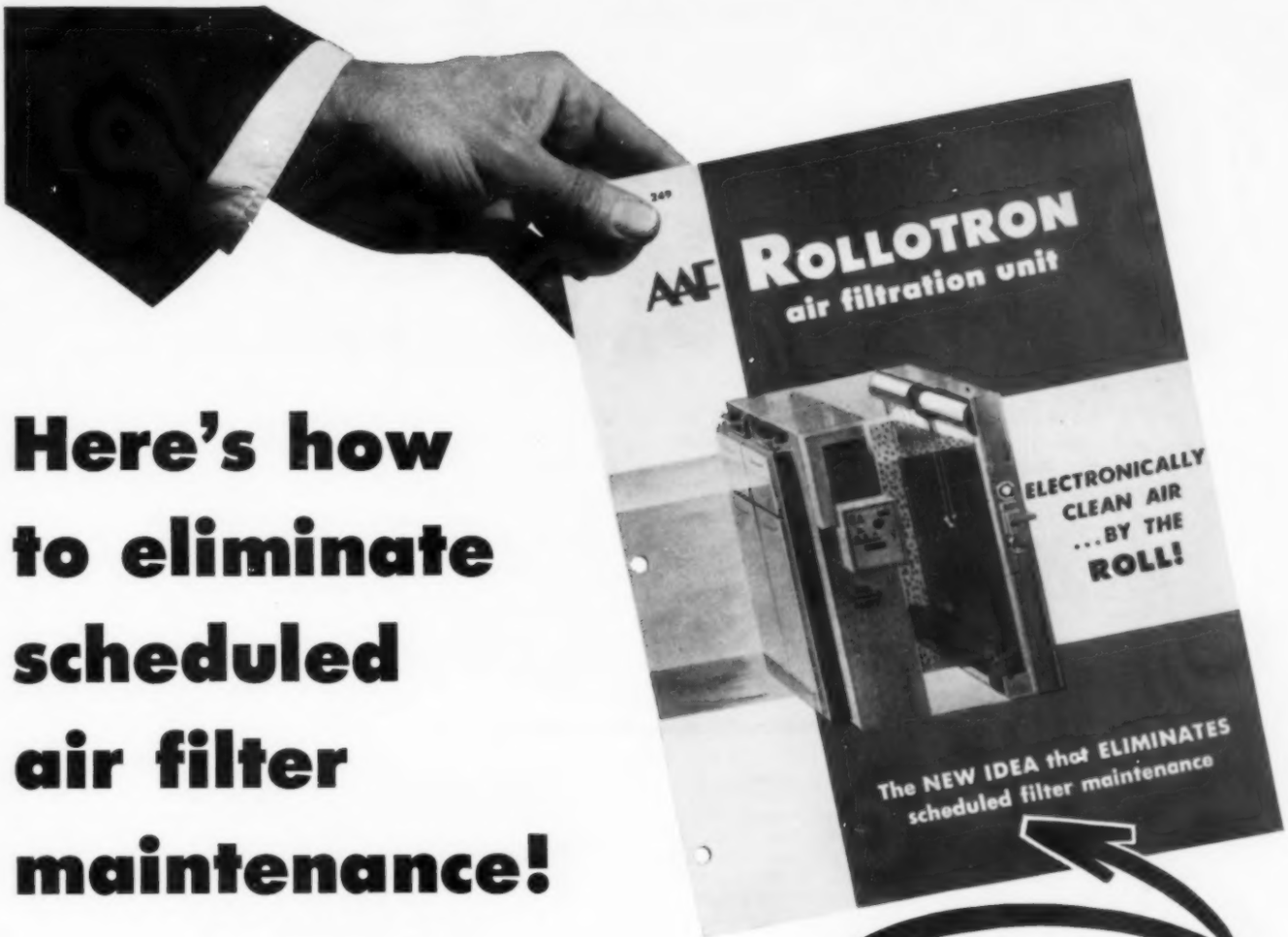
REFINING OF IRON IN THE THOMAS PROCESS

▲ U. S. 2,790,712, issued April 30, 1957 to Henk Henrichs, assigned to Mannesmann Aktiengesellschaft, describes a modification of the Thomas process for refining iron, by blowing with air in a converter, in the presence of a slag and flux containing "red mud," a waste by-product of the recovery of alumina from bauxite. Thus, a by-product of the aluminum industry is made available for use in the steel industry.

APPLYING EXOTHERMIC MATERIAL TO THE HOT-TOP OF STEEL INGOTS

▲ U. S. 2,791,816, issued May 14, 1957 to Erich C. Pletsch and Michael Bock II, assigned to Exomet Inc., describes a method of applying exothermic material to the hot-top of steel ingots.

The ingots are poured "short," meaning from ⅓ to ½ the height of metal usually poured into the hot top—or about 5 to 7 per cent of the volume of the ingot. After pouring the ingot, and after waiting a relatively long time, until the steel has cooled to a point approaching



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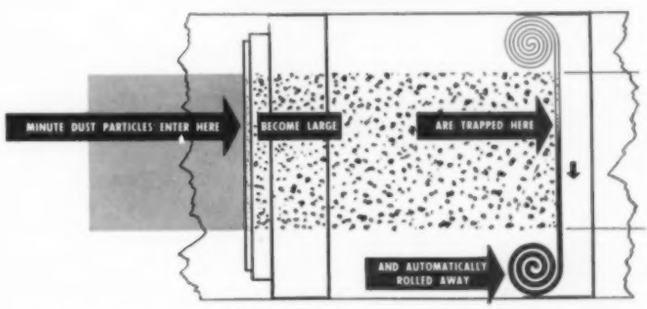

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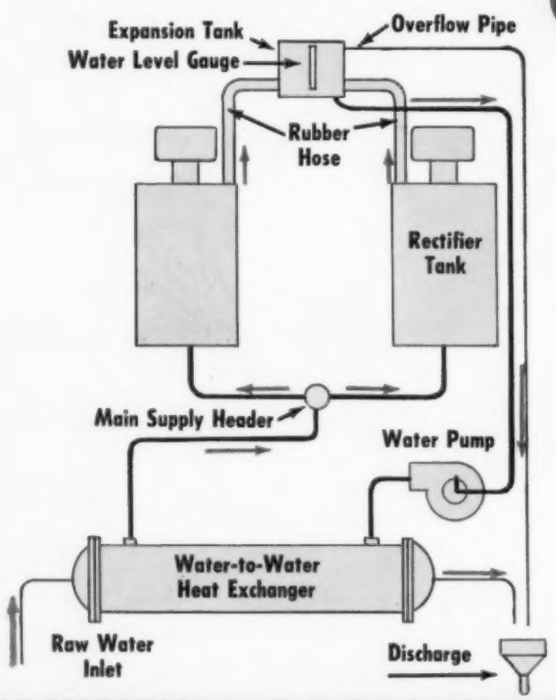
How the System Works

Water is normally pumped through the water-to-water heat exchanger to the main supply header from where it circulates through rectifier tubes picking up heat. Hot water flows up through the short connections to expansion tank and back down to suction side of water pump.



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Factory-packaged units cut installation time and costs. Sealed tube rectifiers are supplied in completely enclosed or open types. Here is a typical, completely enclosed, 1000-kw, 250-volt rectifier for steel mill service.

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solidification, a highly exothermic material is released on the metal in the hot top. The exothermic material contains Fe_3O_4, powdered aluminum and slag-forming material. This reheats the steel in the hot-top, and enables it to feed the steel in the ingot mold, causing any pipe to form in the hot-top rather than in the ingot.

TOP STRUCTURE FOR BLAST FURNACE

▲ U. S. 2,792,213, issued May 14, 1957 to John S. Stewart, describes a top structure for blast furnaces, which eliminates the double bell construction and in its place provides a chute into the top of which the charge material is fed from a distributing hopper, the material being split into a number of separate streams which flow through branch chutes into the top of the furnace. The material is automatically delivered into the furnace in response to the subsidence of the level of the furnace charge, and seals off and prevents the escape of gases via the chutes.

As shown in Figures 5 and 6, charge material for the blast furnace F is delivered into the upper end of an inclined chute 1. In the bottom of this chute for a portion of its length is a perforated plate 2 for screening out fines, which drop into a hopper 3 and a storage bin 4. The charge material is unloaded into the chute 1 from a skip 5, and the material discharging from the lower end of the chute is received in a charging or distributing hopper 6. This leads into a vertical chute 7, which is provided with a charge-level indicator 8. The vertical chute 7 at its lower end divides into two branch chutes 10 and 11, the angle of which is greater than the angle of repose of the materials.

Enclosing the upper end of the shaft is a cylindrical metal hood 13, forming an expansion chamber for the gases issuing from the shaft. An offtake duct 14 opens through the wall of the hood and may lead to a dust collector. The bottom of the hood is provided with a grating 15 through which the fines given up by the gases are free to fall into a dust bin 16, equipped with doors 17 for removal of the collected fines from the bin.

(*Please turn to page 28*)

Figure 5

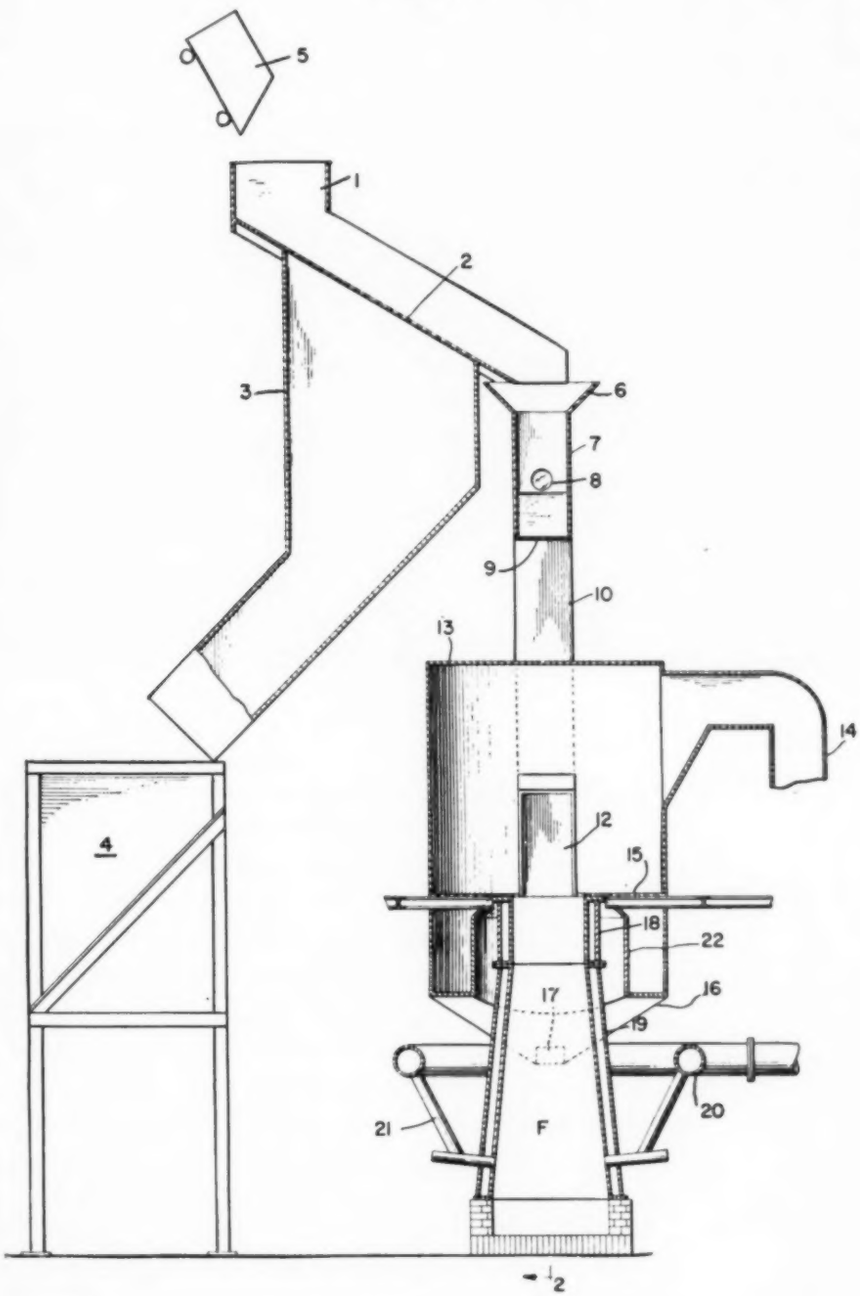
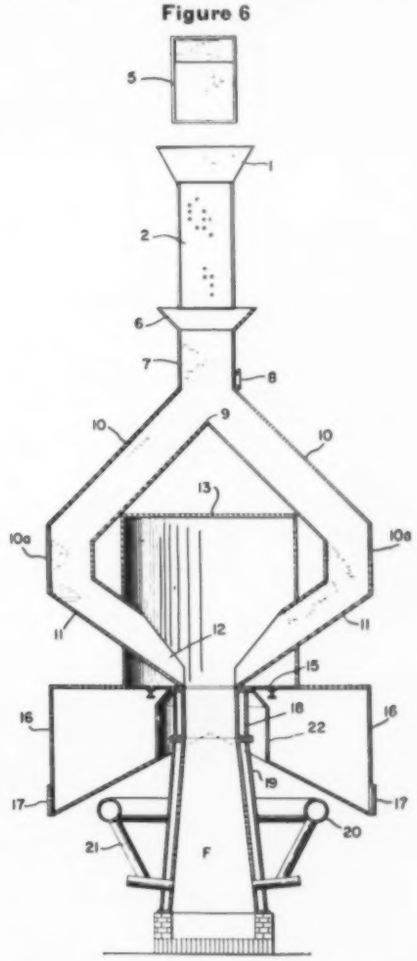
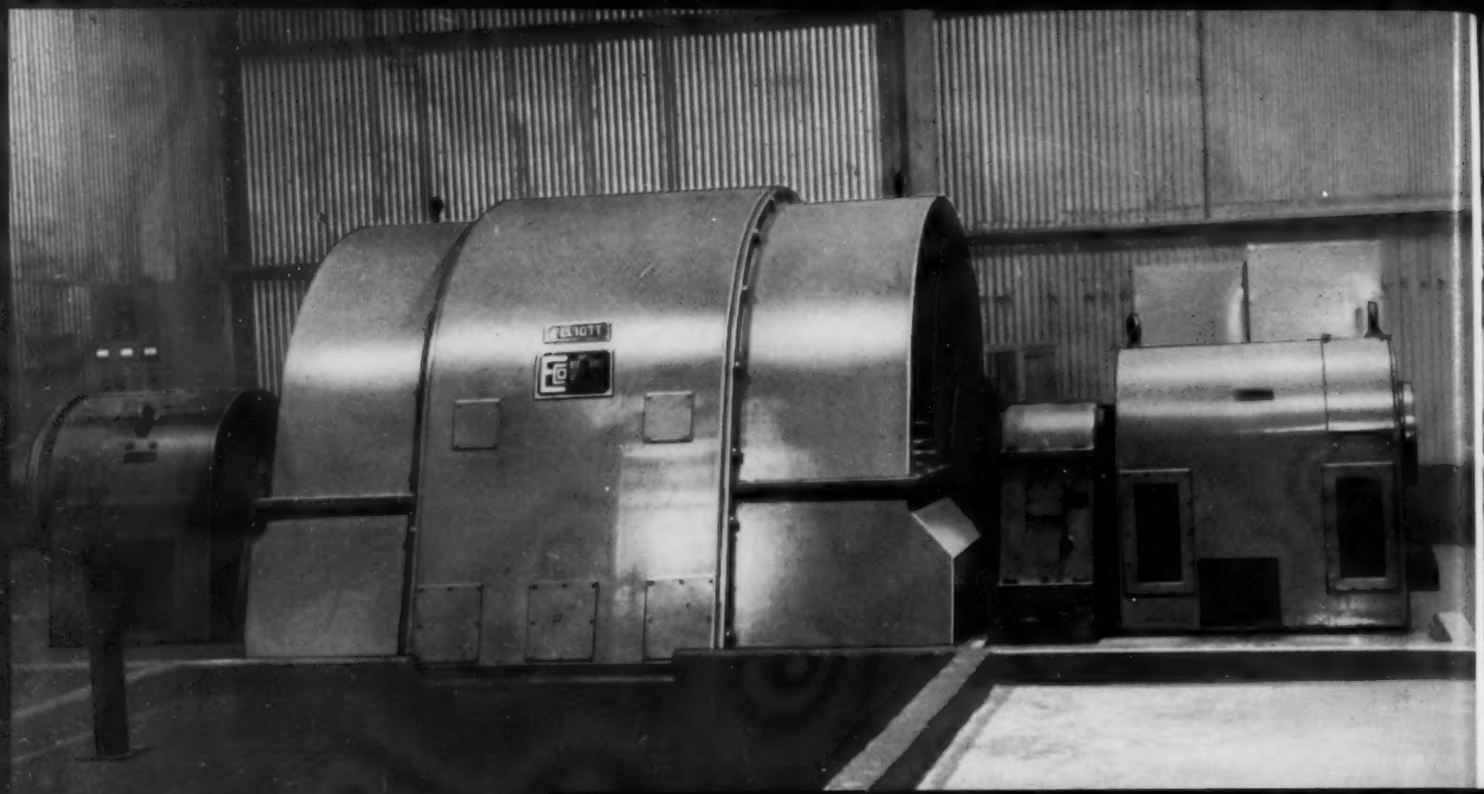


Figure 6

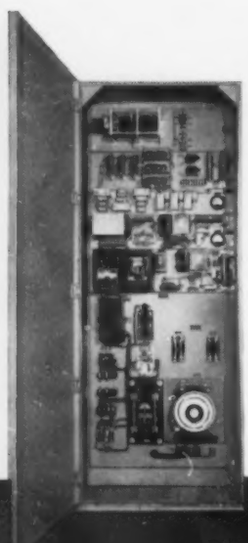




The above 20,000-kva, 900-rpm Elliott air-cooled synchronous condenser controls voltage flicker in a midwestern steel mill in connection with twin 60-ton electric arc furnaces. Direct-connected main and pilot exciters are self-cooled with filtered air inlets. A wound-rotor starting motor has a similar cooling system. The condenser is cooled by an air-to-water heat exchanger mounted in a pit beneath the floor.

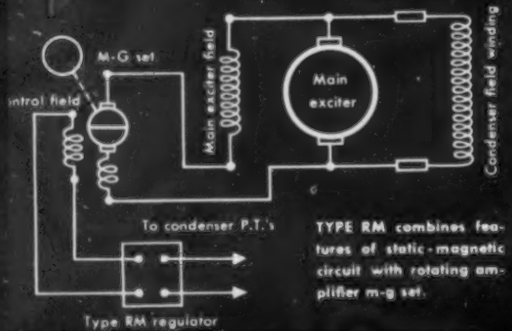
TWO MORE SYNCHRONOUS

controlling flicker voltages



An Elliott-engineered and built regulator control which insures full protection and instrumentation. This cubicle contains major static components of an Elliott excitation system.

Excitation systems furnished with Elliott synchronous condensers are specifically designed—electrically and mechanically—to individual installation requirements.

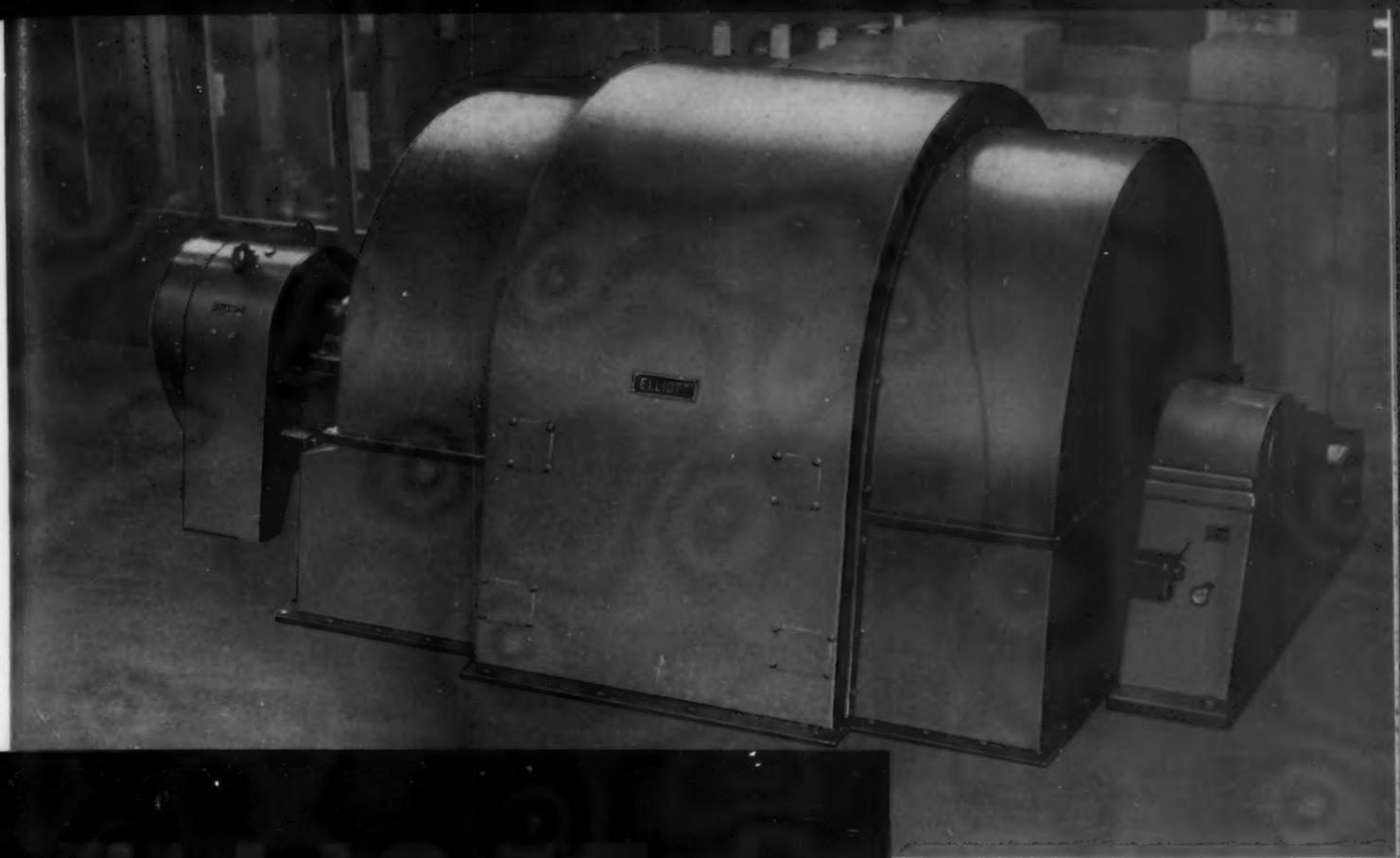


TYPE RM combines features of static-magnetic circuit with rotating amplifier m-g set.

Elliott Synchronous Condensers have established excellent records in electrical systems requiring power factor correction, automatic voltage regulation and improved system stability during faults. The units shown above are typical of successful installations all over the country, ranging from 20,000 to 50,000 kva, both air and hydrogen-cooled.

Each Elliott unit is individually tailored—electrically and mechanically—to the particular operating problem, whether it be lower-than-standard subtransient reactance, higher-than-standard excitation response, or special lagging kvar capacity performance.

In "normal" service, probably no other electrical machines are called upon to withstand such mechanical and thermal stresses as are synchronous condensers.



Here a 30,000-kva, air-cooled Elliott synchronous condenser serves two furnaces and other mill loads in a prominent steel mill.

ELLIOTT CONDENSERS

. . . in steel mills

Elliott machines are specially designed and built to meet these severe requirements. Stator and rotor windings are heavily braced and supported to prevent destructive movement of the windings under stress.

Evidence of high-quality workmanship is seen in every detail of machine construction. In fact, the entire Elliott synchronous condenser is designed to simplify installation, inspection and maintenance.

For complete construction and application data, call your nearby Elliott District Office or write Elliott Company, Ridgway Division, Ridgway, Pennsylvania.

write for free engineering data

Write for Bulletin PB 5800, giving detailed information on the construction and application of Elliott synchronous condensers.

R7-15

ELLIOTT Company

(*Continued from page 25*)

FURNACE LINING

▲ U. S. 2,792,214, issued May 14, 1957 to George R. Eusner and Michael A. Orehoski, assigned to United States Steel Corp., describes a basic brick lining for use in open-hearth furnaces.

The rate of deterioration of basic brick in open-hearth furnaces is mainly a function of the porosity of the brick. In the present invention, this porosity is reduced by impregnation with molten metal and subsequent oxidation thereof. The metal may be aluminum, magnesium, chromium, titanium, or calcium or alloys of these.

The impregnated brick may be used immediately in laying up a furnace lining, or they may be heated in an oxidizing atmosphere so as to oxidize the metal.

An alloy of 65 per cent magnesium and 35 per cent aluminum is desirable, for impregnation, since its volume change on oxidation is practically zero.

MANUFACTURE OF LOW-PHOSPHORUS STEEL

▲ U. S. 2,793,110, issued May 21, 1957 to Johannes Kosmider and Herbert Neuhaus, describes a process for manufacturing high grade steel of low phosphorus content in a bottom-blowing converter through the bottom of which air is blown under pressure, in which the melt is dephosphorized by rapid formation of basic liquid slag containing ferrous oxide.

During the bottom-blowing with air at a low speed of decarbonization, oxygen and steam are also blown against the surface of the bath at 3 to 5 atmospheres and at a velocity low enough to preclude penetration of oxygen into the molten bath. A slag-liquefying material such as lime is also added to the bath at the start, and from time to time. Some ore is also added, during the blow.

As a result, the dephosphorization is wholly or partly advanced in time into the decarbonization period.

OTHER PATENTS OF INTEREST TO THE IRON AND STEEL ENGINEER

Patent No.	Date	Subject	Inventor or Assignee
2,790,530	4/30/57	Billet-dispatching conveyor for rolling mills	Western Electric, Inc.
2,790,533	4/30/57	Apparatus for inspecting metal sheets after hot-dipping	United States Steel Corp.
2,790,739	4/30/57	Method of coating core plates in the production of silicon steel sheet stock	United States Steel Corp.
2,791,139	5/7/57	Rolling mill guide	United States Steel Corp.
2,791,191	5/7/57	Cover for soaking pits	Loftus Engineering Corp.
2,791,416	5/7/57	Heating furnace for operation with blast furnace gas	Huttenwerke Phoenix A.G.
2,791,418	5/7/57	Floating lifting lugs for annealing cover	United States Steel Corp.
2,791,460	5/7/57	Hand tool for feeding strip to a rolling mill	United States Steel Corp.
2,791,517	5/7/57	Chromium-coating steel surfaces by the diffusion process	Deutsche Edelstahlwerke A.G.
2,791,814	5/14/57	Ladle nozzle and stopper construction	Oscar Villela
2,791,997	5/14/57	Furnace with radiant tube	United States Steel Corp.
2,792,132	5/14/57	Automatic control of the stock-line in a blast furnace	Erie Mining Co.
2,792,133	5/14/57	Apparatus for unloading pallets	United States Steel Corp.
2,792,211	5/14/57	Apparatus for heating and quenching metal parts	National Electric Products Corp.
2,792,298	5/14/57	Production of sponge iron	Horace Freeman
2,792,299	5/14/57	Recovery of iron from ores of high titanium content	Roy A. Halversen
2,792,300	5/14/57	Production of nodular iron	John A. Livingston
2,792,605	5/21/57	Casting of hollow ingots	English Steel Corp. Ltd.
2,792,795	5/21/57	Partible soaking pit cover	Amsler-Morton Corp.
2,792,924	5/21/57	Apparatus for cooling sinter material	Kaiser Steel Corp.
2,792,996	5/21/57	Strip coiling apparatus utilizing a belt wrapper	United States Steel Corp.
2,793,027	5/21/57	Heat-treatment of metal articles	Metal Rolling & Tube Co. (Proprietary) Ltd.
2,793,109	5/21/57	Induration process for powdered iron oxide containing material	Surface Combustion Corp.
2,793,112	5/21/57	Treatment of manganese ore	Bethlehem Steel Co.
2,793,113	5/21/57	Creep-resistant steel	Hadfields Ltd.
2,793,114	5/21/57	Production of superior cast iron	Meehanite Metal Corp.
2,793,144	5/21/57	Removal of molten lead from a traveling steel wire	Bethlehem Steel Co.
2,793,147	5/21/57	Salt bath for heat treating carbon alloyed steel	Albert Erdmann & Co.
2,793,176	5/21/57	Apparatus for charging horizontal coke ovens	Koppers Co., Inc.

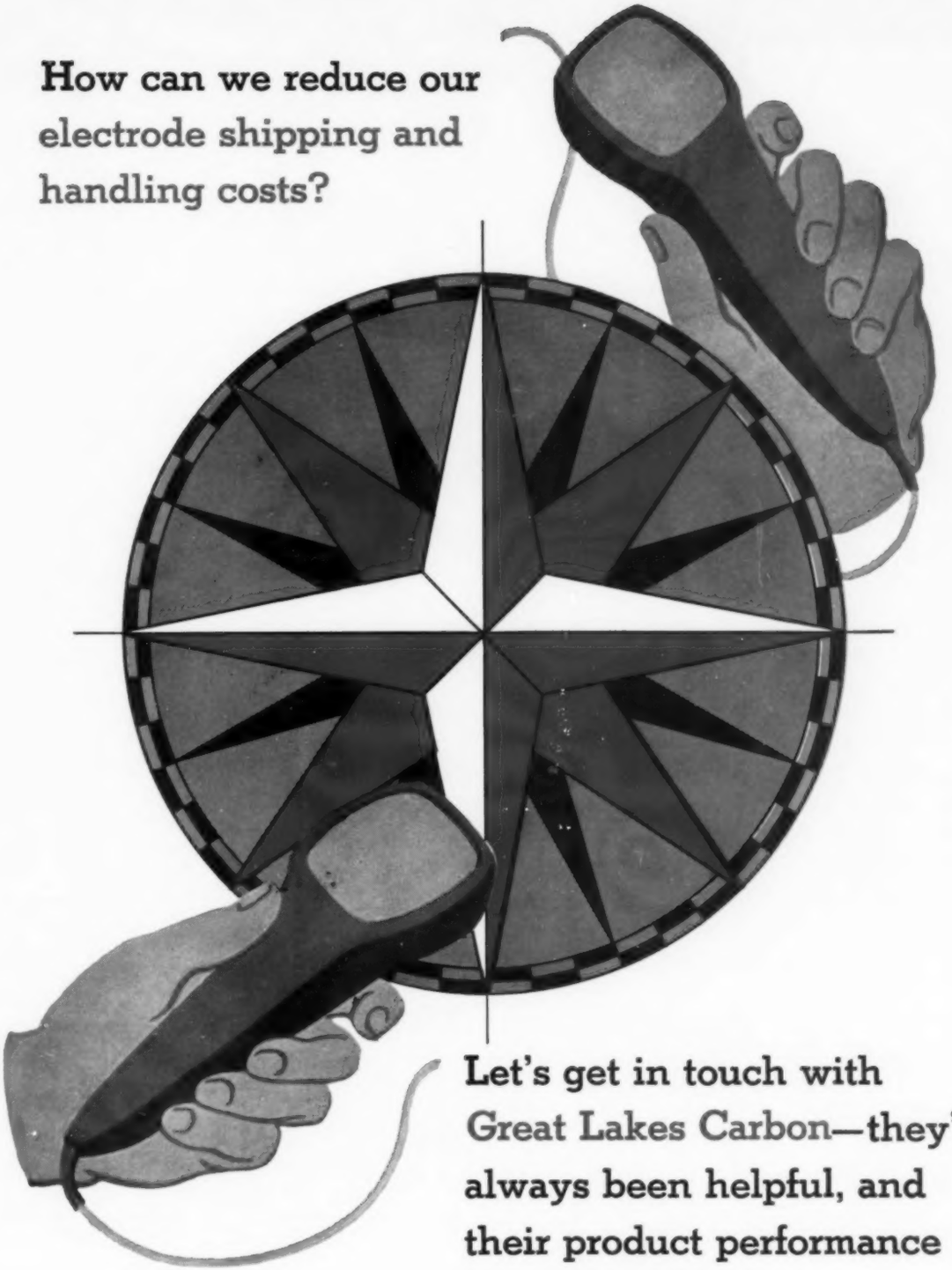
There is constant demand for copies of "The Modern Strip Mill,"

published by the Association of Iron and Steel Engineers.

If your copy is not in use please get in touch with us.

ASSOCIATION OF IRON AND STEEL ENGINEERS, 1010 EMPIRE BLDG., PITTSBURGH 22, PA.

How can we reduce our electrode shipping and handling costs?



Let's get in touch with Great Lakes Carbon—they've always been helpful, and their product performance is outstanding!

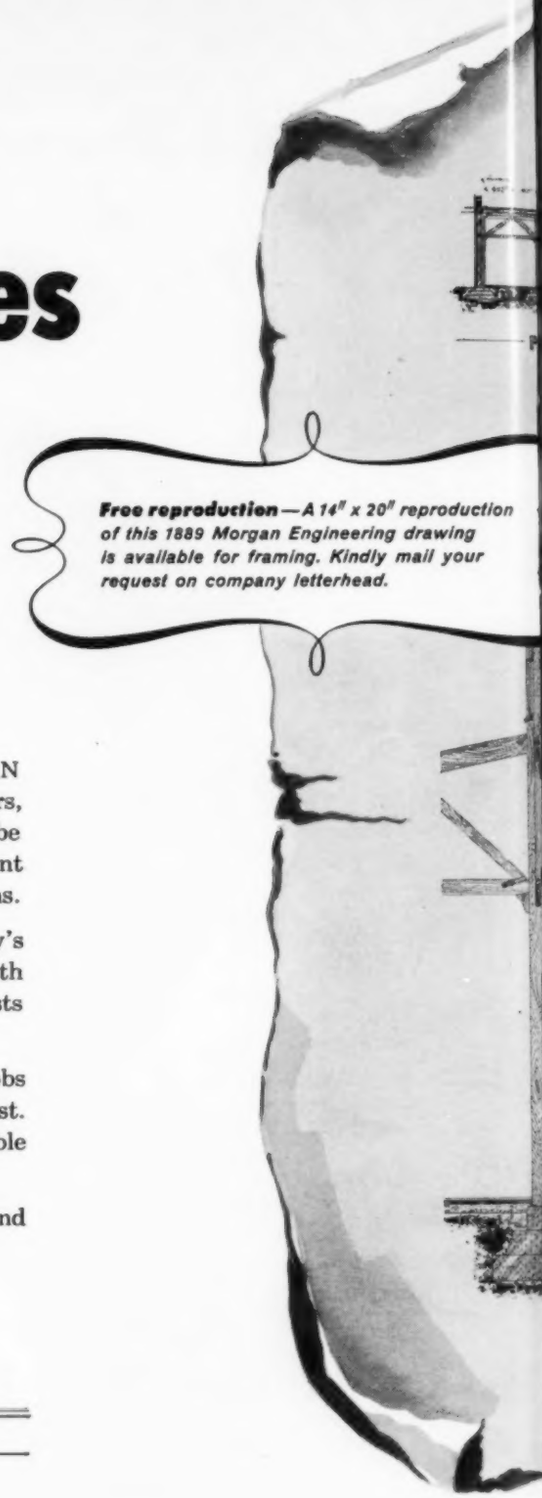
ELECTRODE GLC® DIVISION

GREAT LAKES CARBON CORPORATION

18 EAST 48TH STREET, NEW YORK 17, N.Y. • OFFICES IN PRINCIPAL CITIES

For bonus power, speed and dependability

Morgan cranes and mill equipment



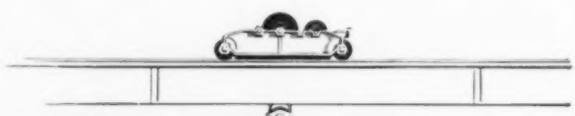
Free reproduction *— A 14" x 20" reproduction of this 1889 Morgan Engineering drawing is available for framing. Kindly mail your request on company letterhead.*

Look back—Remember how often you have seen the name MORGAN on cranes, charging machines, blooming and slabbing mills, shears, saws and auxiliary mill machinery? Wherever great weights must be lifted or big blocks of metal are worked, you find Morgan equipment . . . at the the key spots in maintaining continuous-flow operations.

Inventive engineering and 89 years of close contact with industry's needs have resulted in greater speed, capacity and efficiency with Morgan-built products . . . lower operating and maintenance costs . . . absolute dependability.

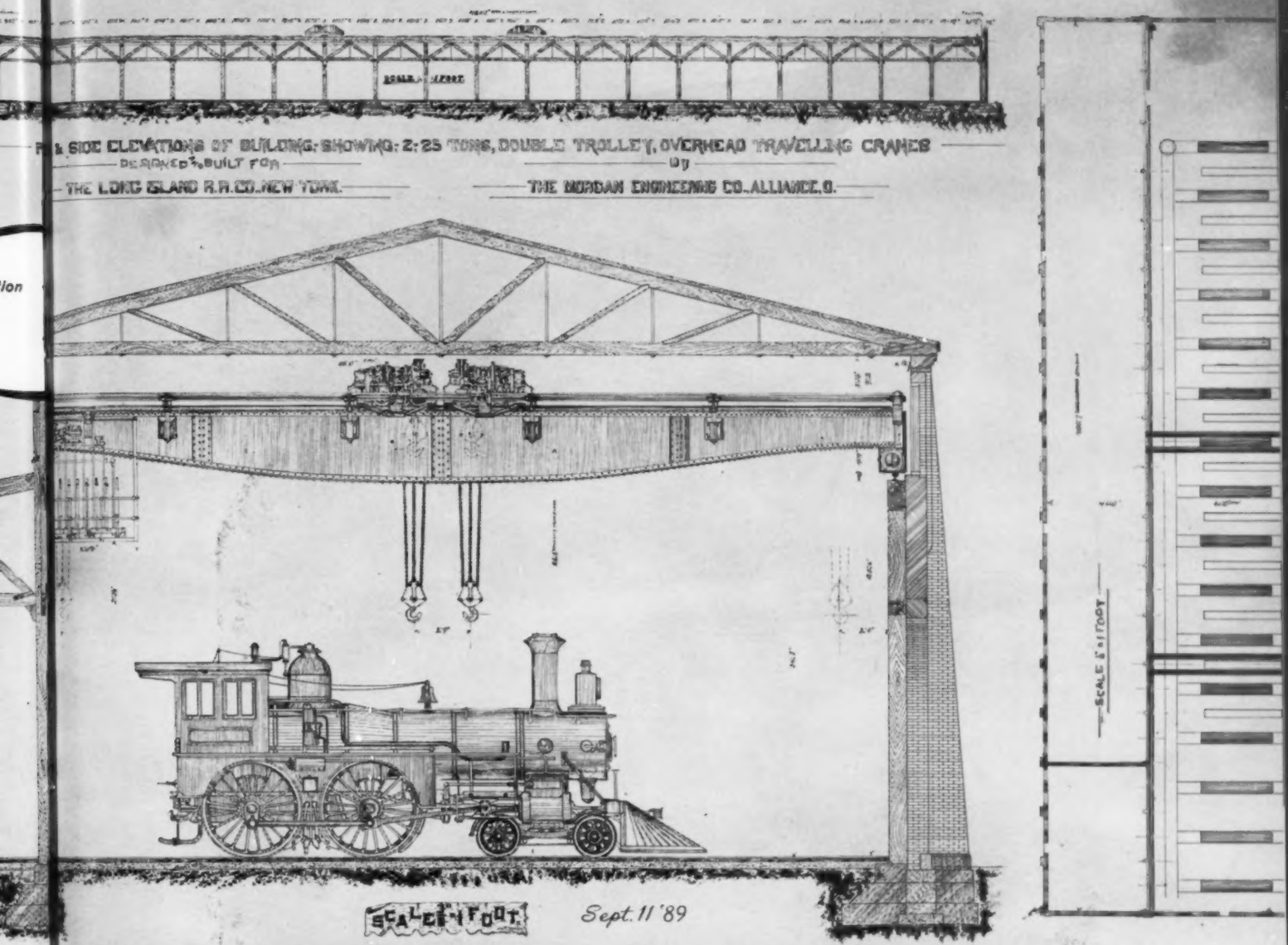
Look ahead—When you buy equipment to handle the big tough jobs year after year, savings cannot be measured in terms of initial cost. They must be measured in terms of uninterrupted, more profitable production.

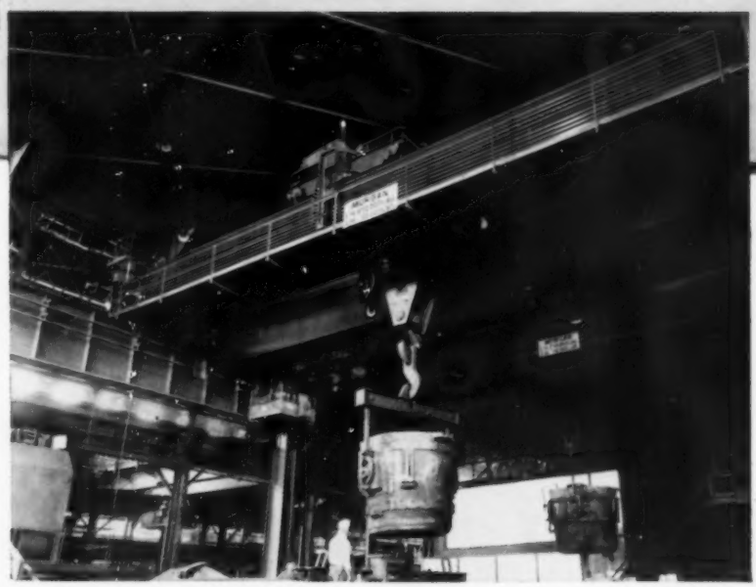
Let our representative help you plan to speed production and lower costs with Morgan cranes and mill equipment.



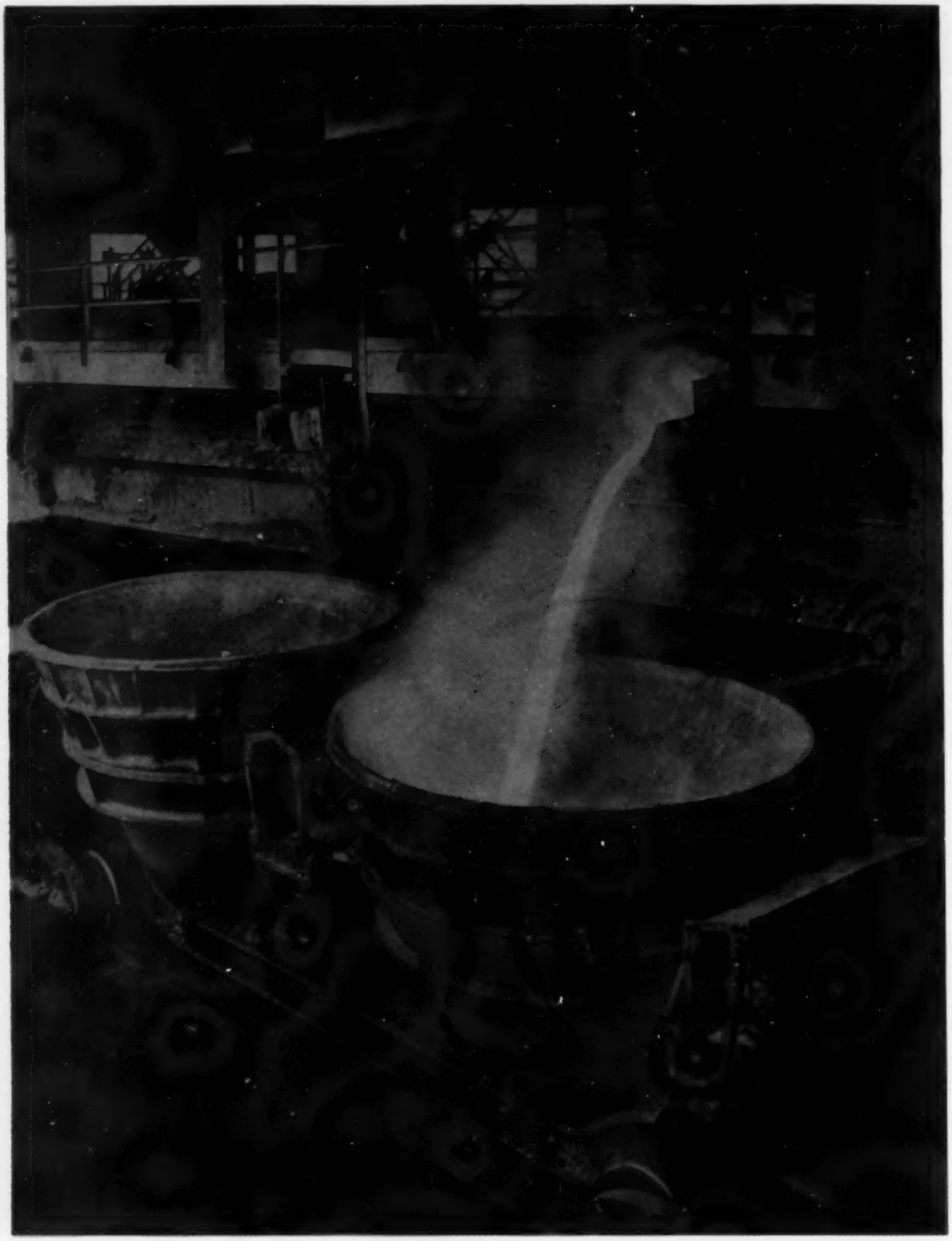
THE MORGAN ENGINEERING CO. *Alliance, Ohio*

Overhead electric traveling cranes, gantry cranes, open hearth special cranes, plate mills, blooming mills, structural mills, shears, saws and auxiliary equipment.


& SIDE ELEVATIONS OF BUILDING SHOWING 2-25 TONS DOUBLE TROLLEY OVERHEAD TRAVELLING CRANES
DESIGNED & BUILT FOR
THE LONG ISLAND R.R. CO. NEW YORK.
BY
THE MORGAN ENGINEERING CO. ALLIANCE, O.
SCALE 1 INCH = 1 FOOT
Sept. 11 '89
SCALE 1" = 1 FOOT



***Today**—These 70-foot span Morgan cranes speed foundry operations. Each crane has a 125-ton main hoist and a 25-ton auxiliary hoist.*



save time and cost with twin-pot cinder cars

Modern steel plants are becoming increasingly conscious of the benefits of twin-pot, electric-dump cinder cars. When used in preference to a pair of single-pot cars, substantial savings in both first and operating costs can be realized.

A Treadwell twin-pot car, like the one shown, will transport more slag per movement—cutting handling and maintenance costs. Furthermore, it provides greater pot capacity for a given track length. Capacity of pots are 400 cubic feet each.

Treadwell cars can be designed for delivery on their own wheels—ready for service at arrival. You save time and money. They are furnished of cast or welded steel construction, with friction or antifriction truck bearings.

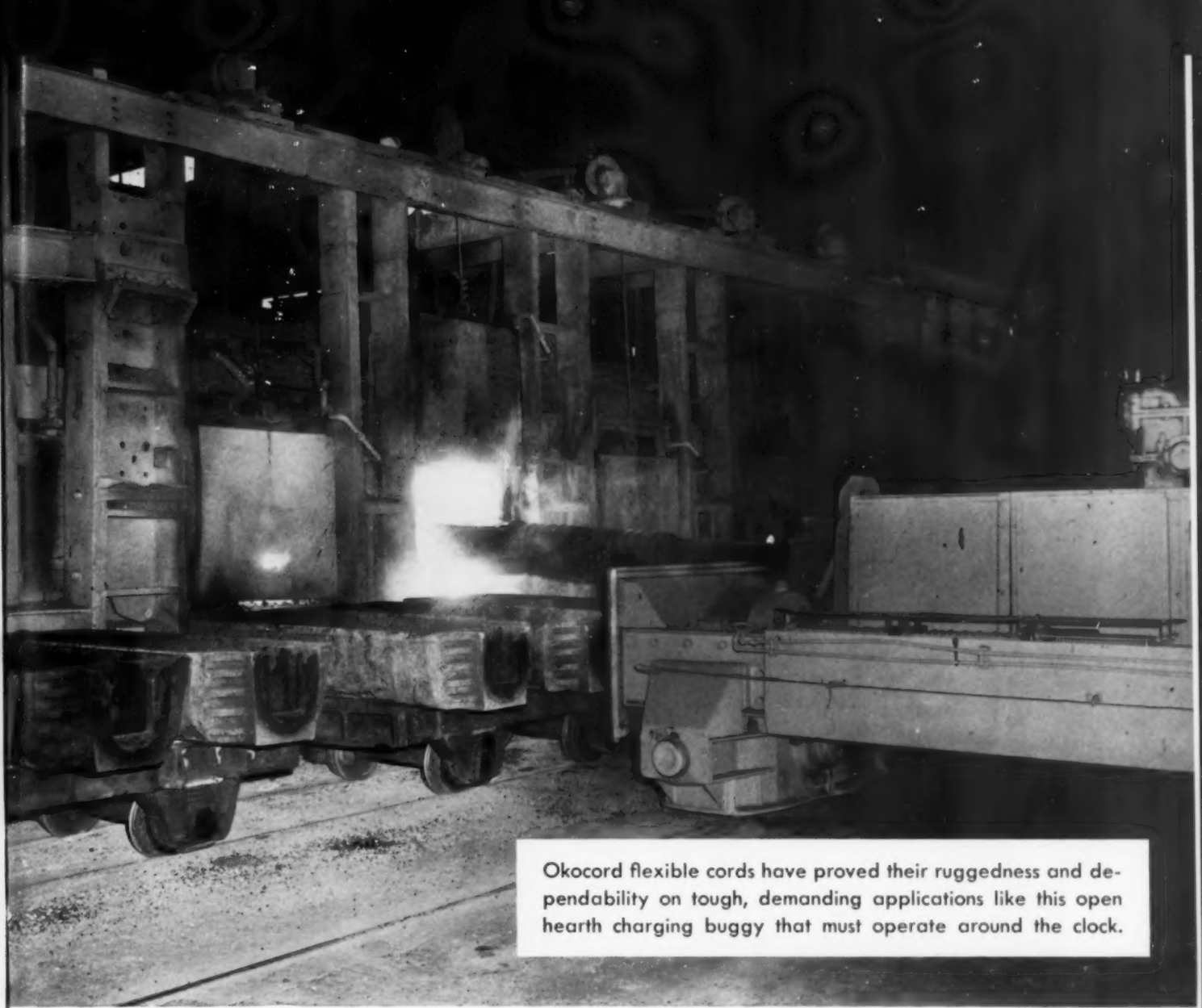
Alternative designs include air-dump cars, and cars with three or four pots of smaller capacity. In fact, Treadwell engineers specialize in meeting customer specifications and service requirements to a T. Remember, more than 2000 Treadwell cinder cars have been placed in service.

For full details, send for a copy of bulletin 61.

M. H. TREADWELL COMPANY, INC.
140 Cedar Street, New York 6, N. Y.
1015 Farmers Bank Bldg., Pittsburgh 22, Pa.
208 So. LaSalle St., Chicago 4, Ill.

TR-27

TREADWELL
CINDER CARS



Okocord flexible cords have proved their ruggedness and dependability on tough, demanding applications like this open hearth charging buggy that must operate around the clock.

Heat and abuse . . . no problem for Okocord* portable cables

The charging machine above is controlled by Okocord flexible cables. They have to withstand constant heat and abrasion. And they're wound and unwound about a small reel every time the charging arm enters the furnace—literally hundreds of times every day.

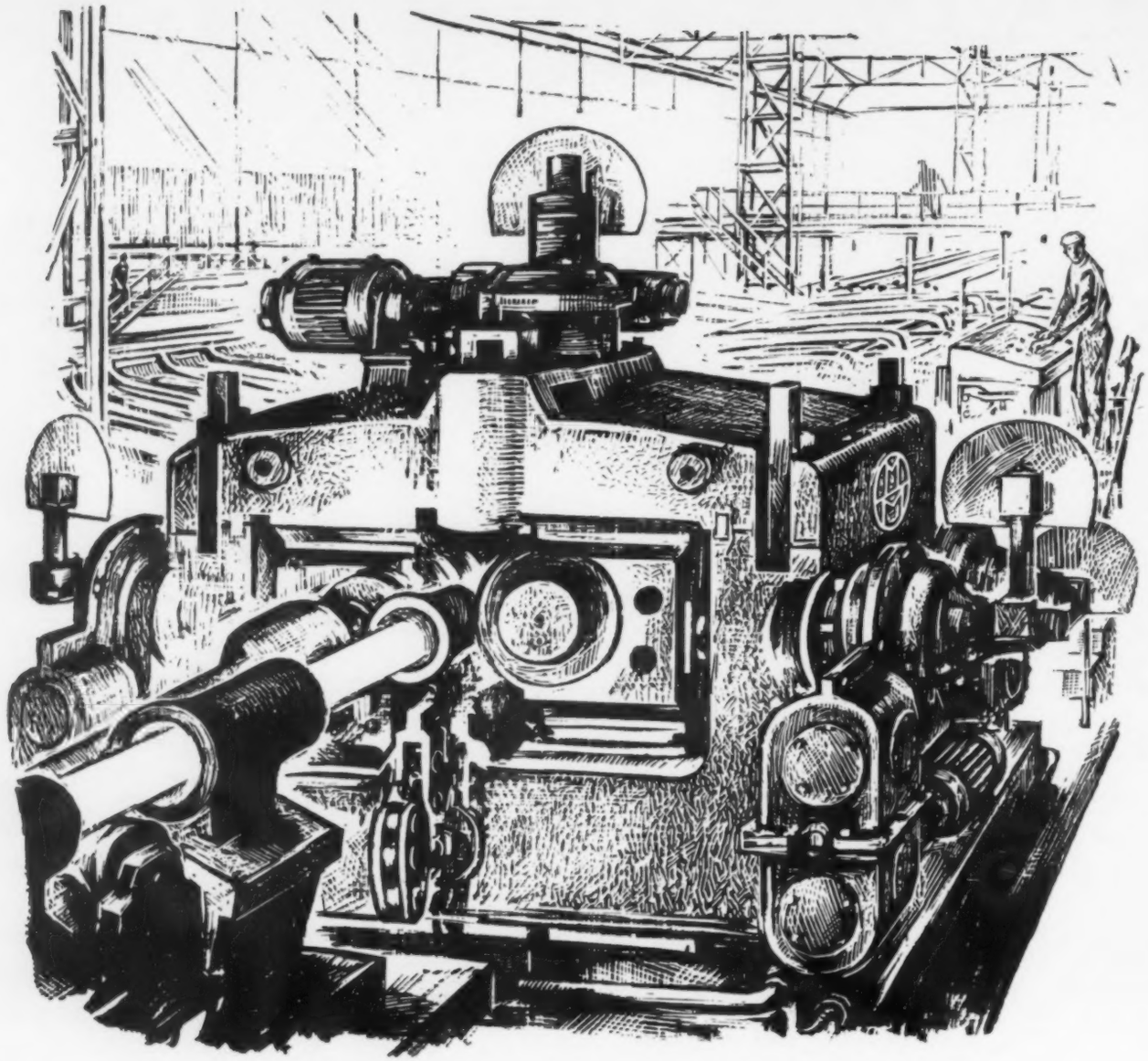
Okocords are used for tough applications like this because they've been proved in service in steel mills . . . and in every other kind of plant. The rugged Okoprene sheath has superior flame resistance . . . plus the tire-tread toughness and extra flexibility that come from being cured in a continuous metal mold. The Okocord conductors have maximum flexibility because they are made of fine copper wires twisted together with a short lay.

Add to this Okocord's carefully-selected, tough, heat-resisting insulation and Okonite's reputation for superior engineering and manufacture . . . and you'll see why you should specify Okocord for every tough portable cord and cable application. Get complete details from your Okonite salesman or write for Bulletin IS-451. The Okonite Company, Passaic, N. J.

*This product formerly carried the trade name Hazacord

where there's electrical power . . . there's **OKONITE CABLE**

4903



Do You Think Your Reelers Are Heavy Enough?

Most seamless mill operators do not think so! Attempts to speed up production of automatic seamless mills usually are stopped at the reelers because they are not heavy enough to take on more work at higher speeds.– Mannesmann-Meer's modern automatic seamless mills are equipped with heavy reelers of the most advanced design. Working rolls have angular adjustment in both planes to allow for variation of the feed angle which will provide ideal rolling of a wide range of sizes and grades of steel. With Mannesmann-Meer reelers it is possible to roll with an expanding pass and still to get good smoothing action.–

Mill design is considerably simplified by driving each roll with a separate motor. A rugged inlet table design features closed barrel guides to end danger and trouble from split guides. Roller type mandrel bar steadiers make possible smoother reeling operation.– In addition to all of these features Mannesmann-Meer reelers are especially designed for quick schedule changeovers.

Why don't you call us in to see what Mannesmann-Meer's outstanding combination of

- CREATIVE ENGINEERING
- DESIGN EXPERIENCE
- OPERATING BACKGROUND
- AMERICAN MANUFACTURING SKILL

can offer you to modernize your seamless mill.

MANNESMANN-MEER

ENGINEERING AND CONSTRUCTION COMPANY, 900 LINE STREET, EASTON, PENNA

WORLD SPECIALISTS IN HIGH-SPEED TUBE MILL MACHINERY

LINDE's method for desulphurization of iron at the blast furnace is simple, efficient, and economical. Principal units are nitrogen supply, dispenser, and injection tube.

MAKE OFF-CASTS MEET SPECIFICATIONS . . . WITH

Metallurgical Carbide from LINDE

With LINDE equipment and UNION calcium carbide, the sulphur content of molten pig iron can be effectively and economically reduced. When you use the LINDE method, you get these advantages: No noxious fumes . . . dry slag does not attack refractory materials . . . treatment is fast, easy to operate and control . . . results are predictable and uniform.

The LINDE equipment includes a large carbide dispenser, adequate nitrogen supply, and graphite injection tube. Fine mesh carbide, carried by a stream of pressurized nitrogen, is injected deep in the hot metal. Using this LINDE method, you eliminate unnecessary pigging costs. And you can gain even greater savings by buying metallurgical carbide in bulk from LINDE.

If you would like to know more about LINDE's improved desulphurization methods and equipment, write today. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. *In Canada:* Linde Company, Division of Union Carbide Canada Limited.

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UNION CARBIDE

The terms "Linde," "Union," and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

Pressurizer for designed with stainless

The reactor we are talking about contains a fissionable nuclear core through which passes thousands of gallons of water per minute at elevated temperature and pressure. This pressurized radioactive water transfers heat from the reactor core to a shell-and-tube-type steam generator which in turn produces non-radioactive steam in the secondary system for power turbine operation.

As power requirements change, the temperature of the primary water is maintained by moving neutron-absorbing reactor control rods in or out of the reactor. Resulting pressure and volumetric changes of the primary water system must be controlled, and this is the job of the pressurizer vessel.

When the primary system water pressure drops, high-capacity back-up immersion heaters at the bottom of the pressurizer go into action to heat the water and generate more steam and maintain pressure. When the primary system pressure goes *up*, water sprays inside the pressurizer are activated to collapse the steam bubble, thus reducing the pressure and permitting positive water surges from the primary system. Since the walls are alternately exposed to wetted and vaporous conditions at high temperatures, a severely corrosive environment exists. Corrosion in this vessel could result in a hazardous level of radioactivity throughout the primary side of the plant. The choice of a proper steel to insure against this hazard was a major consideration. This is why the pressurizer was designed with stainless steel.

Electric furnace and metallurgical staffs worked together to obtain the precise chemical composition specified. Great care was taken during processing in the electric furnace shop. Then, forge press crews, heat treaters and machinists combined skills to produce the finished rings, which certainly rank among the finest USS Quality Forgings ever produced.

Your USS Quality Forging order makes use of the same steel-making facilities, the same processing equipment, and most important: your forging is made by the same skilled workmen in our Homestead Forgings Division.

If you'd like to inquire about a USS Quality Forging made under these conditions, or if you'd like our free 32-page booklet on the subject, please write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS
QUALITY
FORGINGS

heavy machinery parts... carbon, alloy, stainless
forged steel rolls and back-up roll sleeves
electrical and water wheel shafts
specialty forgings of all types

UNITED STATES STEEL

nuclear reactor system steel USS Quality Forgings

Would you take a bath with your socks on?

■ Certainly not accepted practice, but then people do foolish things sometimes. For example, why heat a cover type annealing furnace with radiant tubes? Why not put the heat inside the furnace where it will do the most good. In addition to the high cost of alloy tube replacement, more than 60% of the fuel value is lost up the flue because only the radiant heat is used.

FURNACE ENGINEERS have installed new direct fired or have converted to direct firing, more than 200 cover type annealing furnaces —with their patented eductor system and, without exception, the production capacity and operating economy has far exceeded comparable radiant tube furnaces operating on the same job.

You, too, will find important economies in direct firing—why not investigate the subject fully.

F.E.I. Under New Management

Furnace engineers is now under the management of Mr. A. A. Straub and his associates. Financial and sales policies have been modernized in line with present day demands.

F.E.I. Direct Firing Is 10 Ways Better

- Eliminate costly tube replacement.
- Cut fuel consumption.
- Use more available heat in fuel.
- Permit close control of furnace atmosphere.
- Increase furnace production.
- Faster furnace light-off.
- Bring up furnace temperature faster
- Prevent hot-spots inside furnace.
- Simplify furnace controls.
- Operate furnaces at higher temperatures.

Send for this folder that describes the F.E.I. direct firing system.

Furnace Engineers, Inc.

212 BOULEVARD OF THE ALLIES ● PITTSBURGH 16, PA.

NEW GENERAL ELECTRIC DC MOTOR GIVES

Instant Working Power

KINAMATIC* . . . a new standard in industrial direct current motors . . . designed to deliver drive power at the moment you need it!

Split-Second Response . . . larger air gaps reduce electrical time constants . . . smaller armature diameter permits more rapid delivery of torque to load . . . means faster starts, stops, reversals.

Low Inertia Armature is dynamically balanced, banded with steel and glass . . . gives dependable, high-speed operation . . . skewed armature slots minimize torque pulsation, permit smooth machine operation at low speed.

Other Power Packed Features of new d-c Kinamatic motors help give you more continuous, more automatic production . . . economically.

Additional information is available at your nearest General Electric Apparatus Sales Office. Or, if you prefer, write for Bulletin GEA-6355. *Direct Current Motor and Generator Department, Erie, Pennsylvania.* 813-9

*Trade-Mark of General Electric Company.

Progress Is Our Most Important Product

GENERAL ELECTRIC

ON A FURNACE LINE AT A LARGE EASTERN STEEL PLANT

Furnace Operator

"SEES THE END FROM THE BEGINNING" with RCA Industrial Television!

To permit the operator to see around a long furnace line in an alloy plate building at a prominent steel plant, RCA Industrial TV is used. One-man control of the line from beginning to end is thus possible. Six Television Cameras are connected to TV monitors in the control room. A switching arrangement enables the operator to "switch-in" for observation of the blind areas, some of which are more than 600 feet away. He sees everything that's happening and knows when it's safe to move a plate from the quench press.

Other uses for industrial television include remote observation of rolling mills and shears; heat treatment, open hearth and blast furnaces; smoke stacks, fuel burners. Wherever control of vital instruments, processes, or materials is required, RCA Industrial TV can be counted on for reliable, accurate performance . . . designed and produced by the world leader in electronics.

See the new RCA Type 201 Closed Circuit TV Camera Equipment for industrial application displayed at the National Metal Exposition, International Amphitheater, Chicago, November 4-8, Booth 1494.

Mark of Quality RCA Tmk(s) ®

RADIO CORPORATION of AMERICA
Camden, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

RCA CLOSED TELEVISION

Radio Corporation of America
Dept. Y188, Building 15-1, Camden, N.J.

☐ Please send me latest literature on the use of RCA Industrial TV (Closed Television).

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

☐ Have representative call.

Three Rust-Oleum DIFFERENCES that save you time, money and metal!

GOES ON FASTER

No tedious surface preparations usually required — just scrape and wirebrush to remove rust scale and loose rust — then brush Rust-Oleum 769 Damp-Proof Red Primer right over the remaining rust.

STOPS RUST

Rust-Oleum's *specially-processed* fish oil vehicle works down through the rust into the tiny, microscopic pits in the bare metal where it drives out air and moisture to *stop rust.*

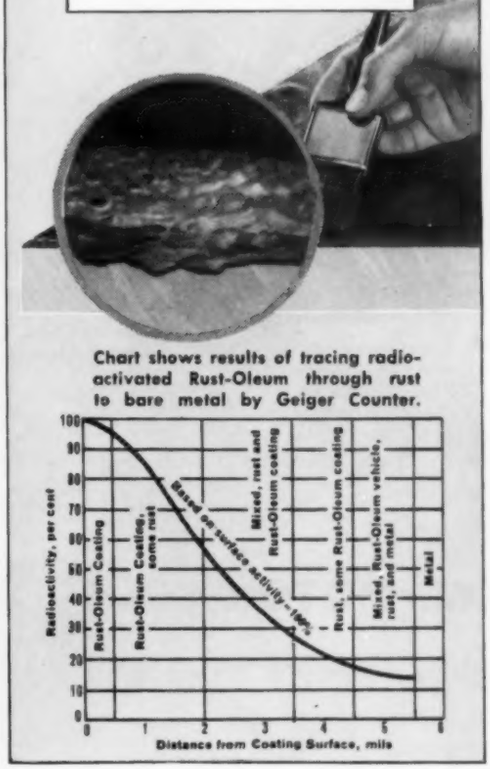
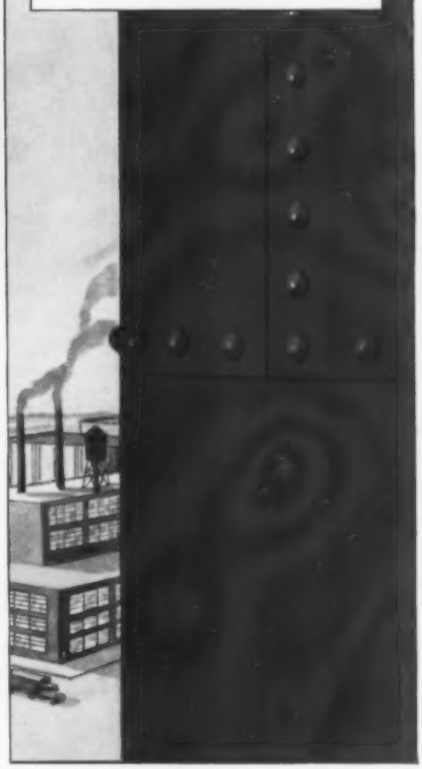


Chart shows results of tracing radio-activated Rust-Oleum through rust to bare metal by Geiger Counter.

LASTS LONGER

Applied over rust, Rust-Oleum lasts longer for the *over-the-years protection* you need. It resists sun, salt water, salt air, fumes, heat, humidity, moisture, weathering.



These are just a few of many important *differences* that separate Rust-Oleum from ordinary coatings. When you consider that Rust-Oleum covers approximately *30% more area,* depending upon surface condition and porosity . . . and the fact that Rust-Oleum finish coatings, with the same fish oil vehicle, are available in nearly every color for *double protection* . . . it's just good, common sense to use Rust-Oleum. Prompt delivery from Industrial Distributor stocks. Write for illustrated literature with color charts.

RUST-OLEUM®

STOPS RUST!®

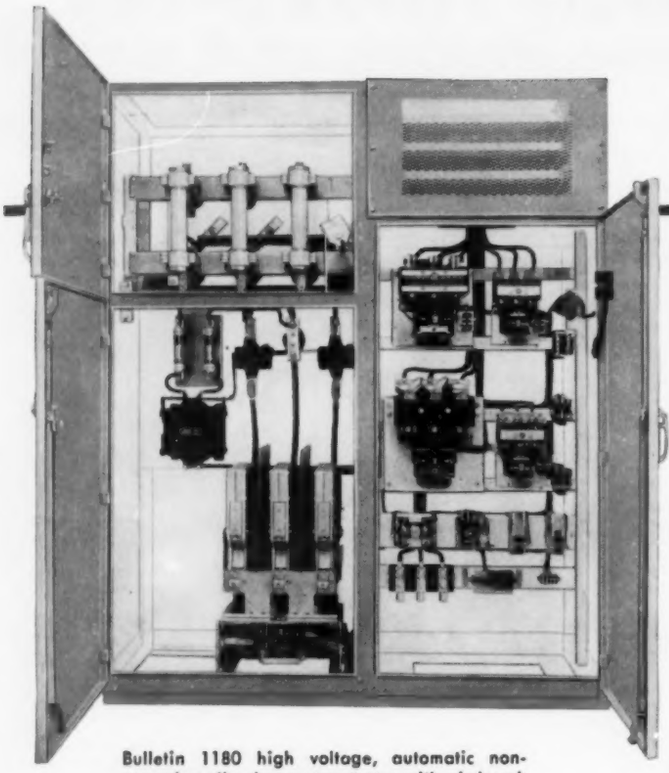
Rust-Oleum is distinctive as your own fingerprint. Accept no substitute.

ATTACH TO YOUR LETTERHEAD — MAIL TODAY

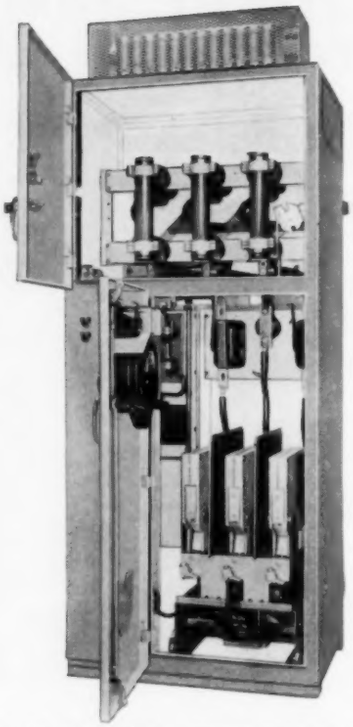
Rust-Oleum Corporation
2443 Oakton Street • Evanston, Illinois

- ☐ Complete literature with color charts.
- ☐ 30-page report on Rust-Oleum penetration.
- ☐ Nearest source of supply.

Rust-Oleum and Stops Rust are brand names and registered trademarks of the Rust-Oleum Corporation.



Bulletin 1180 high voltage, automatic non-reversing slip ring motor starter with air break contactor. Max. rating: 1500 hp, 2000-2500 v; 2500 hp, 2501-4600 v.



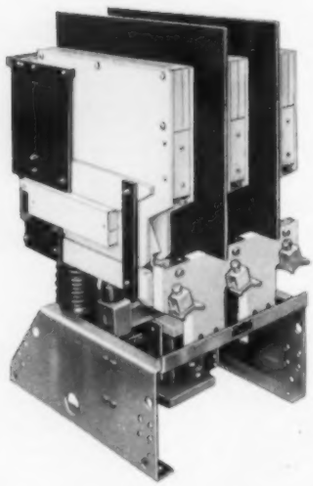
Bulletin 966 high voltage, automatic across-the-line synchronous motor starter with Allen-Bradley air break contactor. Max. rating: 1750 hp, 2000-2500 v; 3000 hp, 2501-4600 v.

The Sign of **QUALITY** Motor Control

A-B QUALITY

HIGH VOLTAGE MOTOR CONTROL

that matches today's steel mill requirements



Unique design and development of new materials made possible an air break switch of amazingly small size. A mechanical life of millions of operations is assured.

This remarkable new AIR BREAK high voltage contactor has an interrupting capacity of 150,000 kva at 2300 volts and 250,000 kva at 4600 volts. The same principles of design that have made the Allen-Bradley low voltage control such an outstanding success have been adopted in the high voltage contactor. The actuating solenoid has only ONE MOVING PART—the magnetic plunger which carries the three moving contacts. The switch has double break, silver alloy contacts which require no cleaning, filing, or dressing. The contacts are always in good operating condition. A new blowout and arc chute design assures rapid arc extinction.

Six different types of high tension, air break starters (like those shown above) are available for across-the-line or reduced voltage starting of large squirrel cage, synchronous, part winding, or wound rotor motors up to 1750 hp, 2000-2500 volts; 3000 hp, 2501-4600 volts. Accurate and dependable relays protect the motor against overloads.

Send for a copy of the Allen-Bradley Handy Catalog which gives complete data on high tension starters with air break and oil-immersed switches.

Allen-Bradley Co., 1343 S. First St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY SOLENOID MOTOR CONTROL

QUALITY

longer life...

One of the unseen extra values you get in every

NATIONAL ROLL

If you are getting only *average* tonnage life from your rolls when a different metallurgical composition would give you *longer than average* tonnage life, let our metallurgists study your problem. They may be able to recommend rolls that will result in considerable savings through reduced down time and longer intervals between roll changes.

The fact that so many long-established steel companies are users of National rolls, and have been users for almost 50 years, is proof of their ability to give long tonnage life . . . and now, to produce even better rolls, National has the additional facilities and metallurgical experience of General Steel Castings Corporation, of which National is a division.

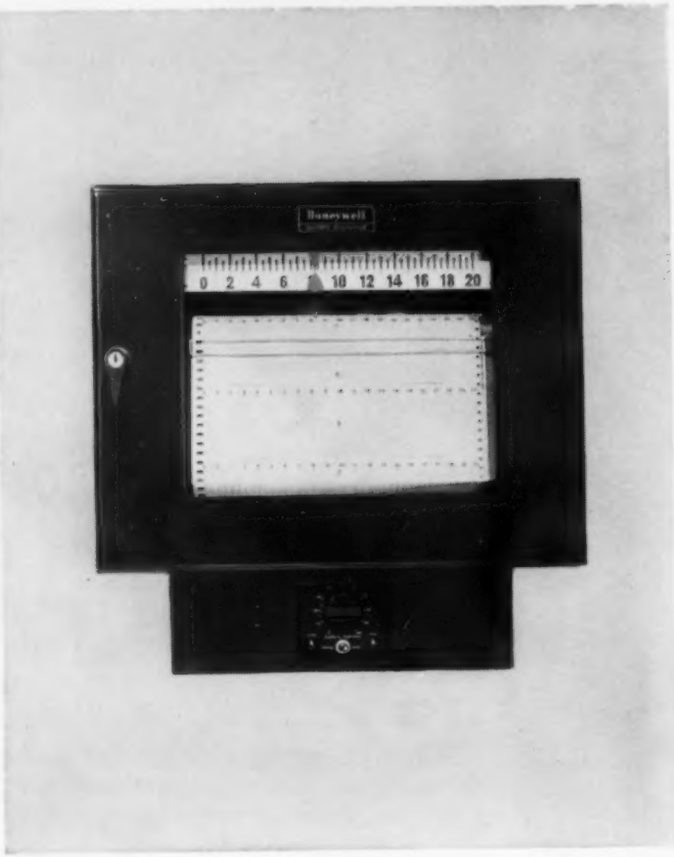
So next time you are ordering rolls—iron or steel—call on us for our recommendations.

GENERAL STEEL CASTINGS CORPORATION

NATIONAL ROLL & FOUNDRY DIVISION

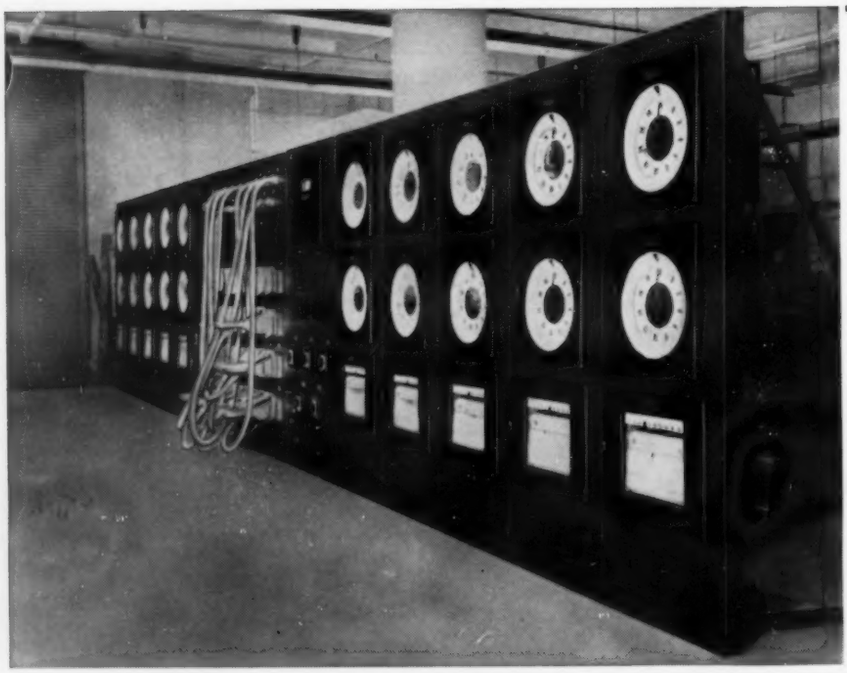
Avonmore (Westmoreland County) Pennsylvania

General Steel Castings Corporation: General Offices, Granite City, Ill. • Plants: Granite City, Ill.—Eddystone, Pa.—Avonmore, Pa.

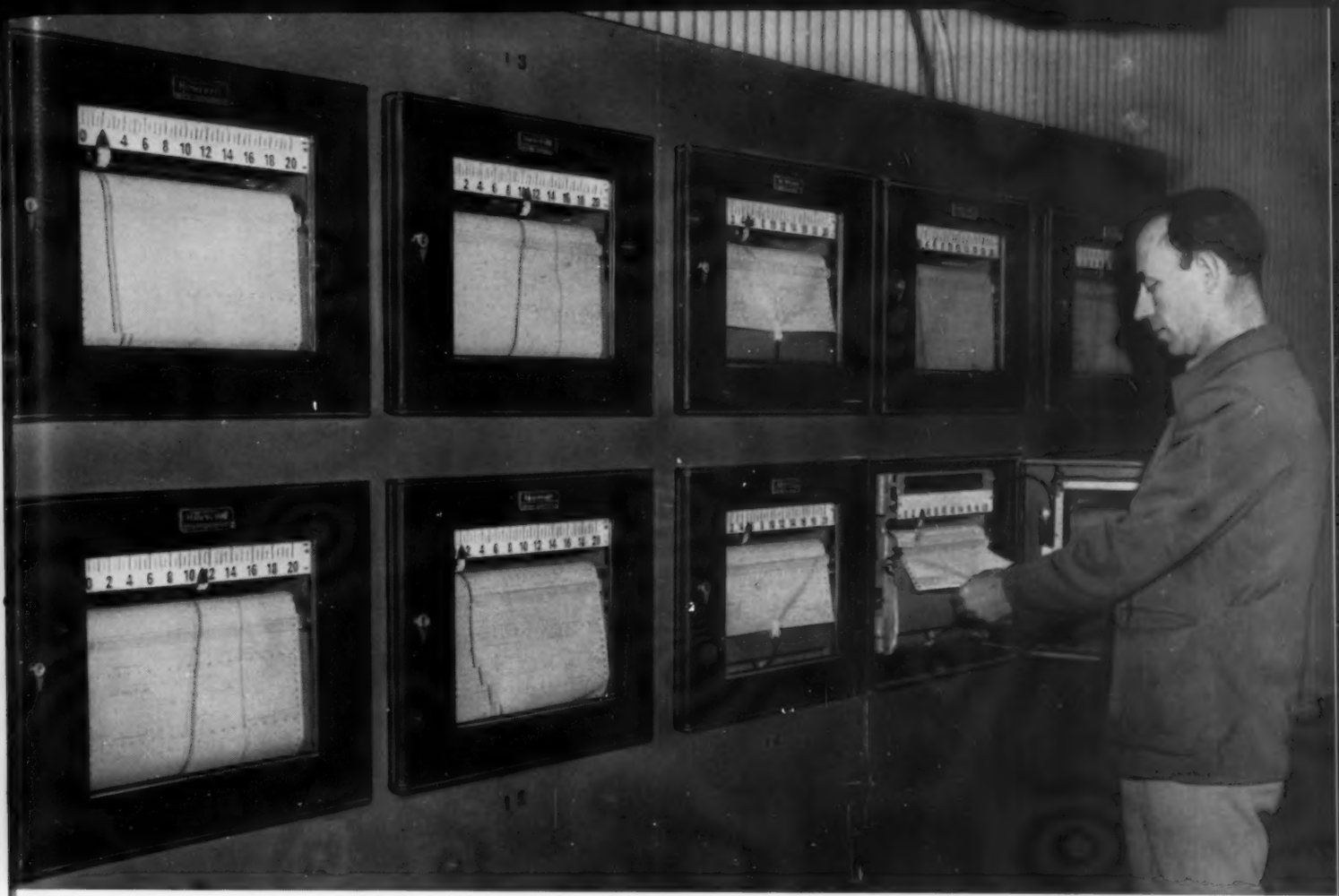


Honeywell annealing cover control system used by most major steel plants has centralized recording and unit cover and work control. At right is the panel of ***ElectroniK*** strip chart instruments which record base and work temperatures in each furnace.

For maximum production on every



Typical Honeywell central control system for an annealing cover installation has circular scale indicating controllers and strip chart recorders, with plug-in connections to covers being used.



heat...use *ElectroniK* instrumentation on your annealing covers

Cover-type furnaces for annealing, normalizing and spheroidizing provide optimum rates of heating, soaking and cooling when controlled by Honeywell *ElectroniK* potentiometers. Fuel savings are an added advantage.

Honeywell supplies controls to suit any specific requirement of radiant tube and direct-fired type furnaces. Controls are custom-fitted to give the fastest cycles consistent with recommended practices. This means you get precise temperature control needed for maximum production and accurately predictable product quality.

ElectroniK instruments are rugged. Mount them on portable covers without fear of damage or loss of performance. Long runs of thermocouple wire won't affect their sensitivity. Safety interlocks protect covers in event of set-point change or power failure.

You have a wide choice of systems. Control can be on-off or proportional . . . electric or pneumatic. There are systems to exactly match the requirements of various cover designs, heating methods and furnace operating procedures . . . including fully automatic programming.

Call your nearby Honeywell field engineer for a discussion of your needs. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Data Sheet 5.2-6a, "Annealing Cover Temperature Control Systems".

Honeywell

H HONEYWELL

First in Controls

HEYL & PATTERSON Rotary R. R. Car Dumper

one ... man
... spotting
... minute
} and your railroad car is completely unloaded and contents weighed

View of the Dumper at Buffington, Indiana Plant, Universal Atlas Cement Company.

- Dumper is designed to rotate, dump and return to initial position in just one minute.
- Rotation can be stopped instantly at any position with car and platen firmly held in place.
- External and movable counterweights have been eliminated.
- Platen-mounted electronic scale is simple, accurate and economical.
- Car retarder on dumper permits economical and safe car spotting by dumper operator.

To achieve the most economical car weighing and dumping operation, the H & P Rotary Car Dumper can be equipped with a car retarder or an electronic scale, or both. This H & P electronic scale platen (Patent Pending) uses load cells which permit instant weighing and light-weighing of car in compliance with National Bureau of Standards acceptance tolerance, and printing of weigh tickets. Exceptional accuracy and trouble-free operation are assured due to absence of wearing parts.

By all standards, the H & P Rotary Dumper is the most efficient method of unloading large quantities of bulk materials from open-top railroad cars.

Even if you receive only a relatively small number of cars per day, may we suggest that you investigate the economics of the H & P Rotary Railroad Car Dumper.

MAIL COUPON TODAY FOR NEW DUMPER BROCHURE 957

HEYL & PATTERSON, INC., 55 Fort Pitt Blvd., Pittsburgh 22, Pa.
Please send me my copy of the H & P Dumper Brochure 957.

Name _____ Title _____

Company _____

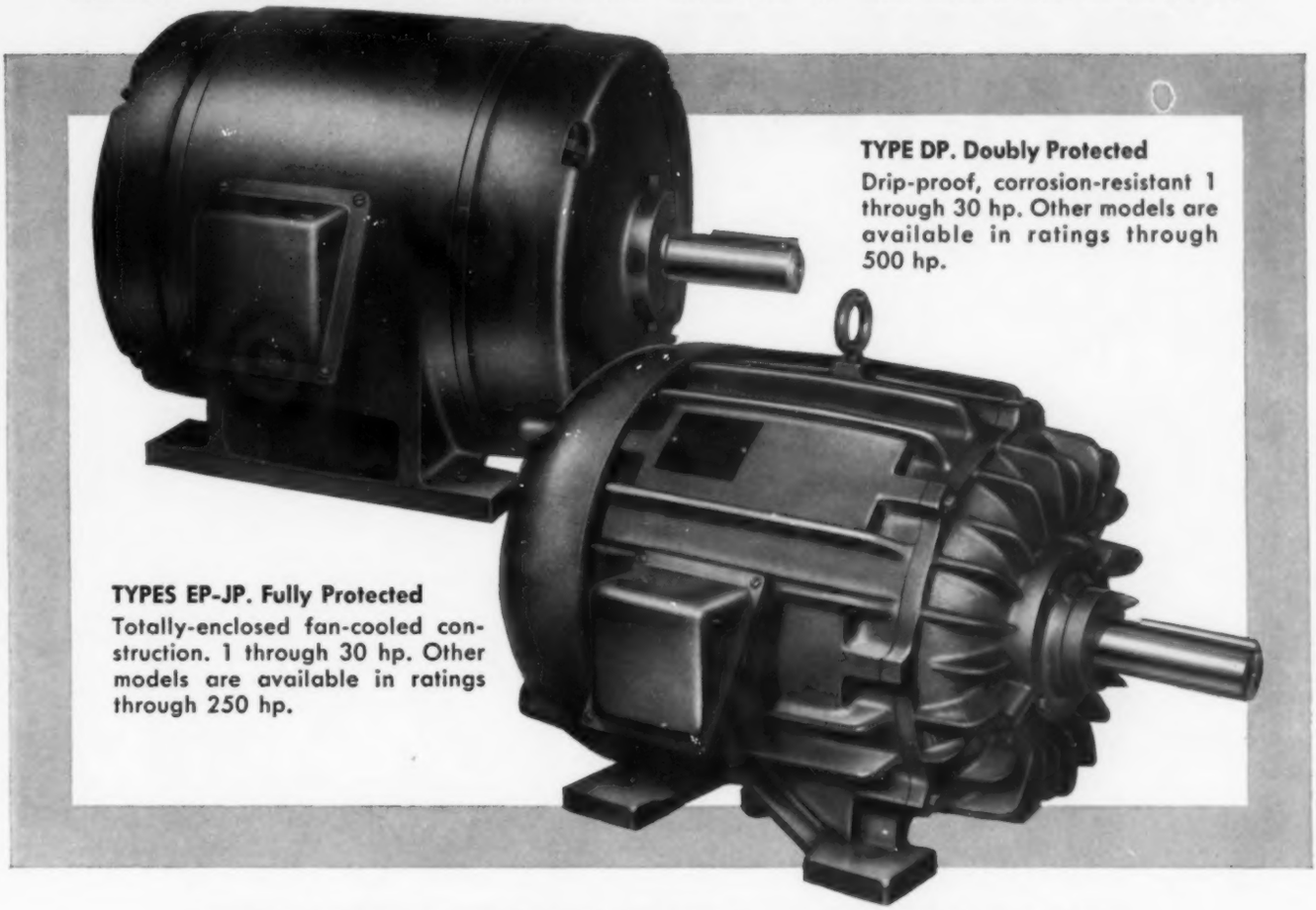
Address _____

City and State _____

70 YEARS OF SERVICE

Heyl & Patterson

WAGNER ELECTRIC MOTORS...THE CHOICE OF LEADERS IN INDUSTRY



TYPE DP. Doubly Protected
Drip-proof, corrosion-resistant 1 through 30 hp. Other models are available in ratings through 500 hp.

TYPES EP-JP. Fully Protected
Totally-enclosed fan-cooled construction. 1 through 30 hp. Other models are available in ratings through 250 hp.

PRODUCTION GOES UP
when you power equipment with these Wagner Motors

Production is increased when motor down-time is reduced. To meet today's industrial demands for faster, more dependable production, Wagner has designed these industrial motors with *extra* protection that cuts time-out for motor maintenance to a minimum.

These motors pack more power in less space—1 through 30 horsepower in NEMA frame sizes 182 through 326 U.

EXTRA PROTECTION—Type DP is doubly protected by a rugged corrosion-resistant cast iron frame and by completely drip-proof enclosures.

Types EP and JP are totally enclosed against dust, grit, fumes or moisture—protected against corrosion by cast iron frames. Type JP is explosion proof as well.

COOL RUNNING—Both types are cool running. Blowers and special baffles direct cooling air through the DP motor. Types EP and JP are fan-cooled and are built with ribbed frames to increase the cooling surface.

LONGER BEARING LIFE—Original bearing lubrication will last for years in service under normal conditions, but openings are provided in the bearing housing to add fresh grease—remove old grease when required.

Let a Wagner motor application engineer show you how well these motors can fit *your* needs. Call the nearest of our 32 branch offices, or write us. Bulletins MU-202 and MU-203 give complete information on these Wagner Motors. Write for your file copies today.

Wagner Electric Corporation
SERVING INDUSTRY SINCE 1891

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

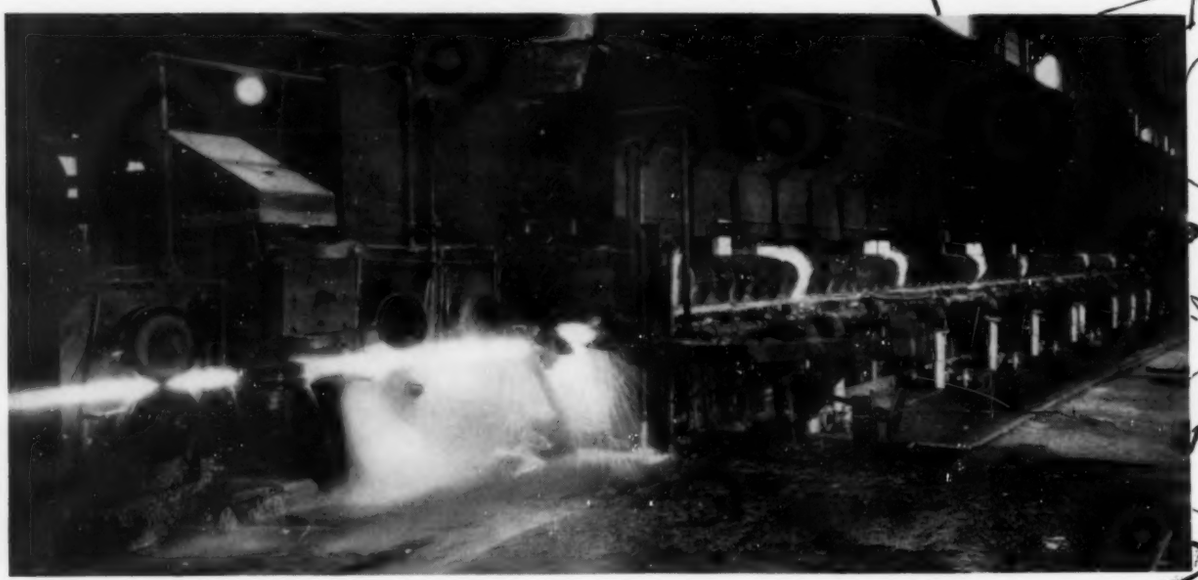
Wagner Electric Corporation
6483 Plymouth Ave., St. Louis 14, Mo., U.S.A.

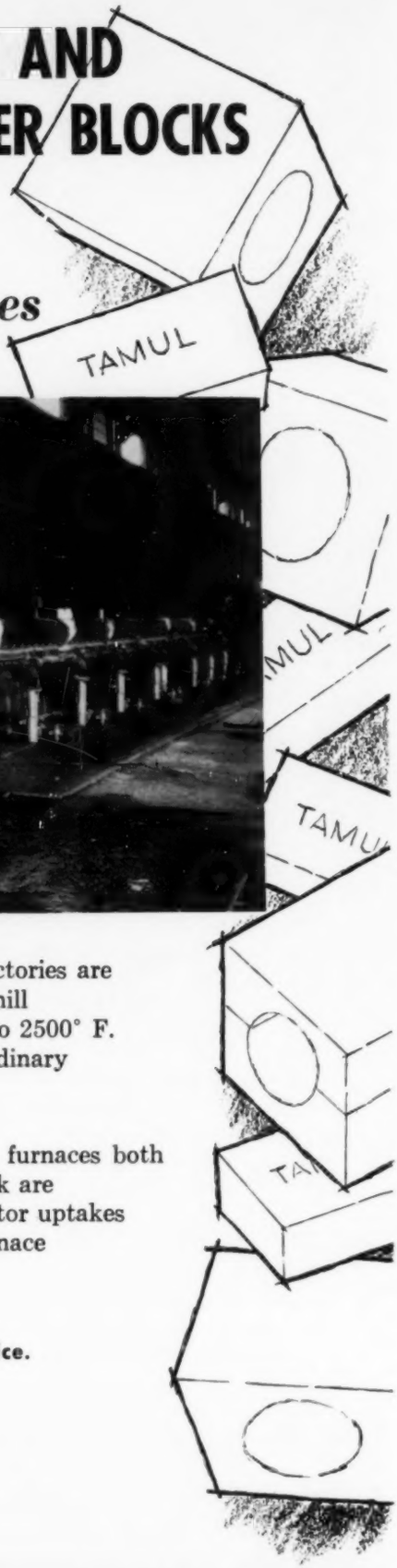
MS7-12

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

TAMUL BRICK AND BURNER BLOCKS

speed production in continuous pipe mill furnaces





TAMUL® (Taylor sintered synthetic mullite) refractories are preferred by operators of continuous butt-weld pipe mill furnaces*. Heating cold skelp for ½" diameter pipe to 2500° F. in 21 seconds produces furnace conditions in which ordinary refractories quickly fail.

TAMUL burner blocks are regularly used in these furnaces both on original installations and on repairs. TAMUL brick are installed in the inner linings of side walls, in recuperator uptakes and in the bungs. This condition results in longer furnace campaigns because TAMUL has:

- **High softening point.**
- **Freedom from shrinkage in service.**
- **High hot load strength.**
- **Good resistance to slagging.**

** Engineered and built by Salem-Brosius, Inc., Pittsburgh, Pa.*

Exclusive Agents in Canada:
REFRACTORIES ENGINEERING AND SUPPLIES, LTD.
Hamilton and Montreal

The **CHAS. TAYLOR SONS** Co.
A SUBSIDIARY OF NATIONAL LEAD COMPANY
REFRACTORIES SINCE 1864 • CINCINNATI • OHIO • U. S. A.

Bucket crane of the Level-Luffing type operates speedily under EC&M Contra-Torque Hoist Control

CONTRA-TORQUE®

Bucket cranes in this fertilizer plant operate at high output with EC&M Contra-Torque Hoist Control

FAST GETAWAY! Quickly responsive to the frequency of the induced-rotor voltage, **EC&M FREQUENCY RELAYS** match torque requirements to the load. They get the motor up to speed quickly for lowering the bucket and moving the trolley in or out. A lot of time saved between trips!

WIDE SPEED SELECTION! These relays permit pick-up of Contra-Torque lowering connections on any master switch speed point. No waiting until last down point is reached. Wider choice of speed gives greater flexibility in clean-up operations and speeds output!

SMOOTH STOPPING ELECTRICALLY! *Off-point braking** brings the descending load to rest and the magnetic brake sets to hold the load. Electrical braking has practically eliminated holding brake wear on many cranes now equipped with this feature.

SPEED-LIMITING! Safety on all speeds. These relays (one set for hoisting and lowering) automatically shift motor connections to safeguard lowering operation with far greater skill than human hands.

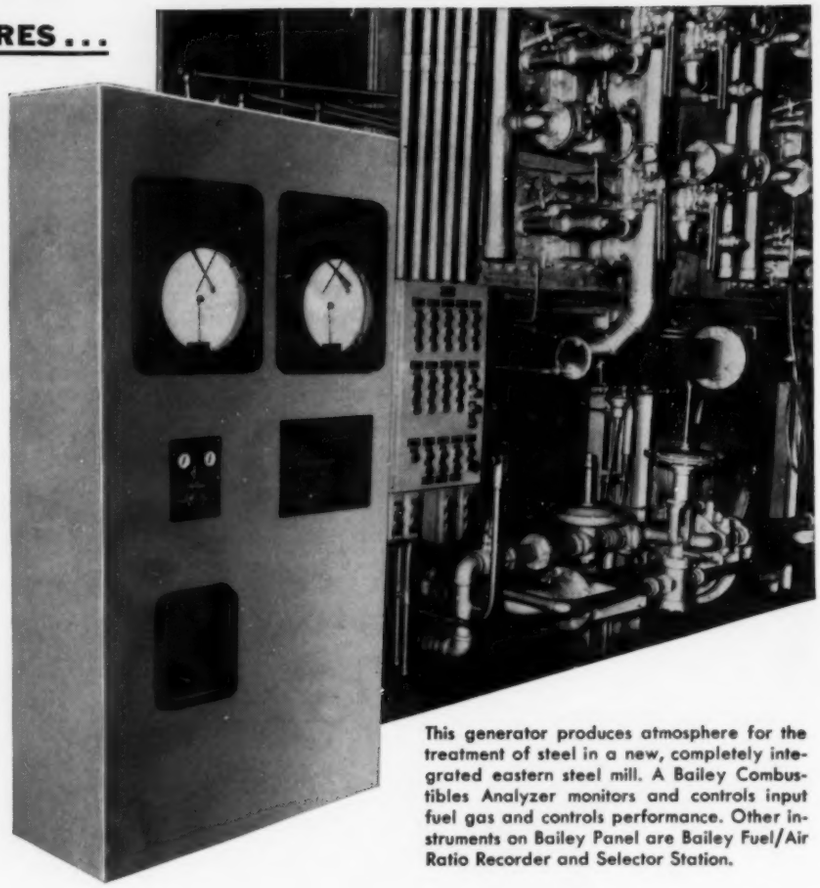
***Off-point braking** to eliminate brake wear
—a new EC&M development for AC bucket cranes

THE ELECTRIC CONTROLLER & MFG. CO.
A DIVISION OF THE SQUARE D COMPANY
CLEVELAND 28 • OHIO

7407

HOW TO CONTROL ATMOSPHERES . . .

BAILEY COMBUSTIBLES ANALYZER



This generator produces atmosphere for the treatment of steel in a new, completely integrated eastern steel mill. A Bailey Combustibles Analyzer monitors and controls input fuel gas and controls performance. Other instruments on Bailey Panel are Bailey Fuel/Air Ratio Recorder and Selector Station.

compensates for variations in gas quality

Whether you are making your heat treating atmospheres out of natural gas or a by-product fuel, variations in gas quality are bound to occur. When this happens, it is impossible to maintain a satisfactory gas-air ratio without exact knowledge of how the atmosphere has changed. The Bailey Combustibles Analyzer provides the logical solution to the problem. In most applications it is sensitive to less than $\pm 0.2\%$ change in combustibles. It also assures uniform atmospheres and a uniform product.

In a commonly used Bailey control system, the Analyzer constantly samples the atmosphere gas. When per cent combustibles varies, a pneumatic signal from the recorder automatically controls the fuel rate to adjust the gas-air ratio and maintain the required amount of combustibles in the atmosphere.

A Bailey Oxygen Analyzer may be combined in the same case with the Combustibles Analyzer. Indicating and recording the per cent oxygen in heat treating atmospheres determines air leakage into the controlled atmosphere furnace. It may also be used as a further safety guide to indicate when a furnace has been purged effectively to permit the use of a hazardous blanketing gas.

Let a Bailey Engineer plan an analyzing and control system for you that will continuously safeguard the quality of your atmospheres and of your final product. Or, write to the Iron and Steel Division for Product Specification E65-3 with complete details on the Bailey Combustibles Analyzer. 59-1

BAILEY METER COMPANY

IRON AND STEEL DIV., 1047 IVANHOE ROAD, CLEVELAND 10, OHIO

In Canada — Bailey Meter Company Limited, Montreal

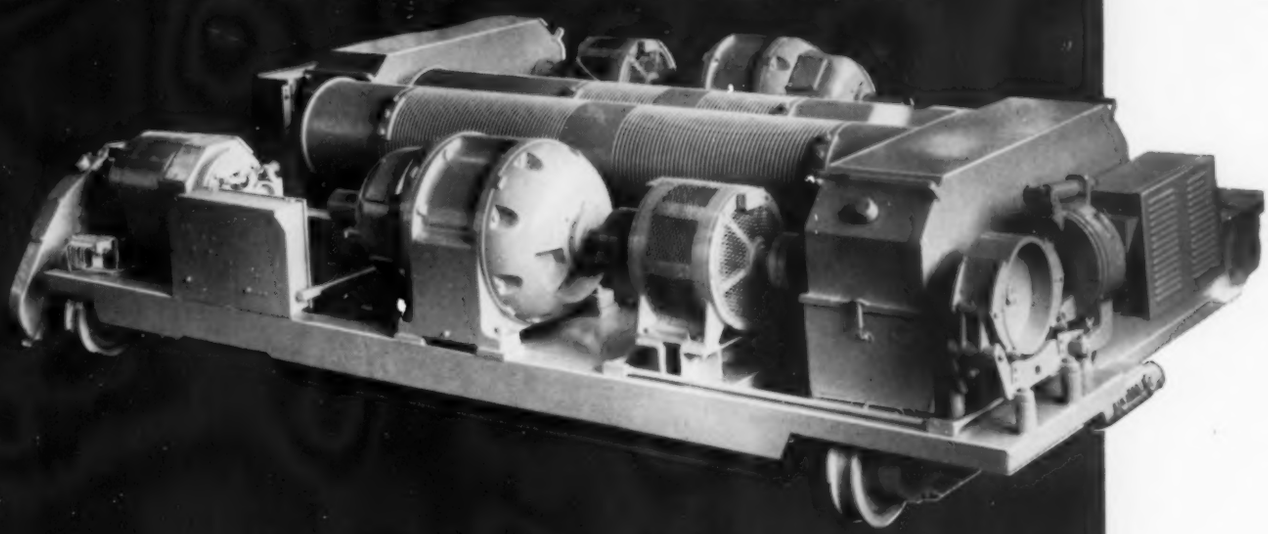
INSTRUMENTS AND CONTROLS FOR POWER AND PROCESS

BAILEY BUILDING BLOCK METHOD

For Northern Cranes

EZOMATIC

CRANE CONTROL



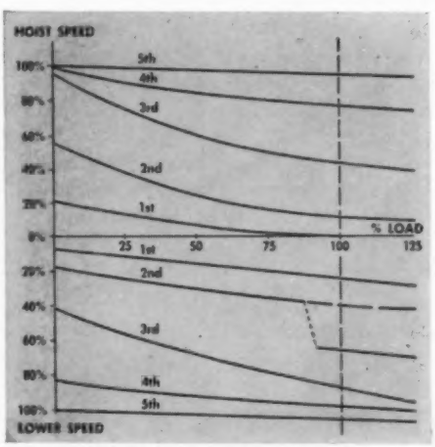
EZOMATIC *is Smooth, Simple, Dependable*

EASIER *to operate*

EASIER *to maintain*

EASIER *to understand*

EASIER *to handle any load*



TYPICAL SPEED CURVES WITH EZOMATIC CONTROL

The new simplified, smooth, accurate control for alternating current hoist motors utilizing full magnetic control combined with an eddy current brake. This improved control arrangement is easier to operate, easier to maintain, makes handling any load easier, safer, more accurate. Regardless of load the speed characteristics both hoisting and lowering are excellent, allowing smooth handling and accurate spotting of any load.

Standard control components familiar to all electrical maintenance and operating men are used throughout. Circuits are simple and readily understandable. No complicated electrical schemes. Used with a standard eddy current brake eliminating mechanical and electrical wear.

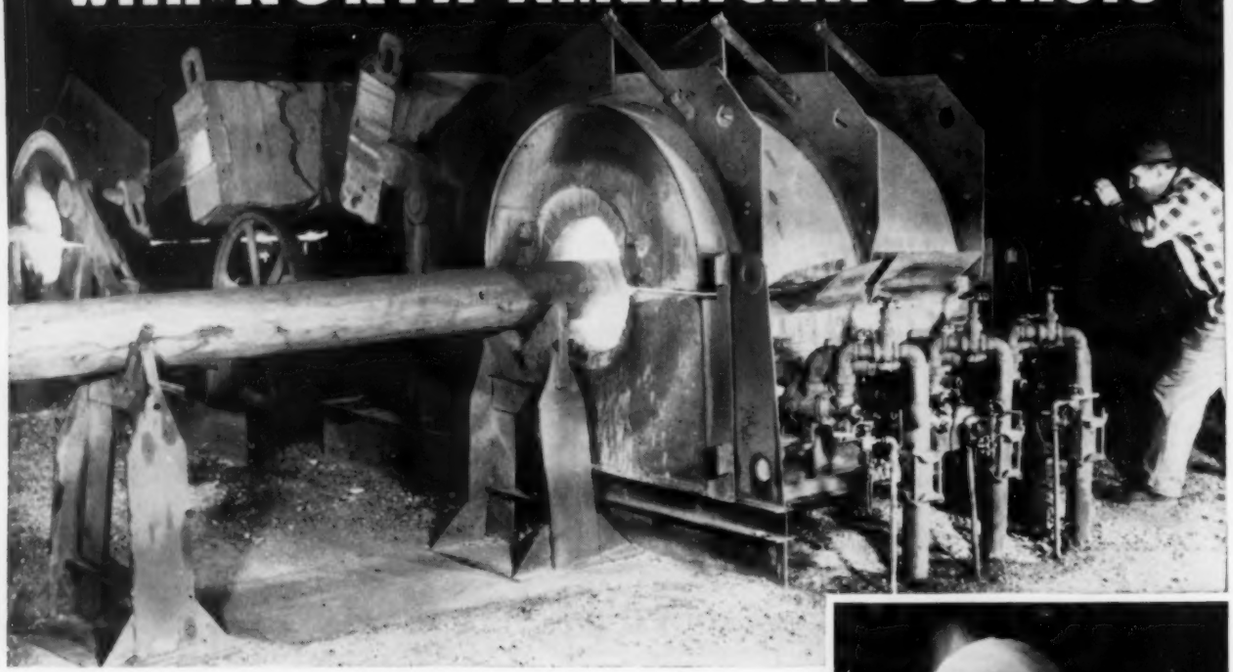
Excitation of the eddy current brake is automatically controlled by the motor speed allowing extra smooth acceleration. If fast acceleration is desired it may be obtained by moving the master switch to the last point, thereby eliminating the eddy current brake excitation. Off point braking is provided automatically to assist the motor brake in stopping the load. The motor brake is automatically applied in lowering if the eddy current brake excitation should be interrupted. Speed curves can be readily changed in the field, either up or down by a simple adjustment. When very heavy loads are handled extra lowering speeds are automatically provided.

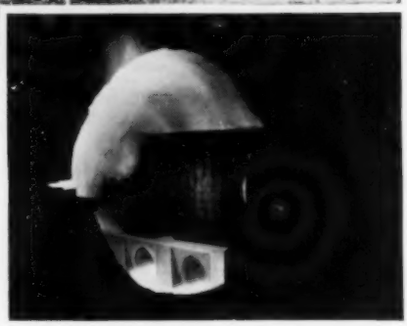
For further information write to

NORTHERN ENGINEERING WORKS

210 CHENE STREET • DETROIT 7, MICHIGAN

Huge Crankshafts
GET HOT IN A HURRY
with NORTH AMERICAN Burners





High speed heating, such as usually applied to small parts in mass production, is used by **Erie Forge & Steel Corporation** for heating huge locomotive crankshafts for die press forging . . . convincing evidence of the efficiency of North American Burners and Blowers.

Amazingly, **#6 oil** is used to fire these compact barrel-type furnaces. North American Blowers and Series 212 Burners provide thorough atomization for fast heat release.

8⅞" billets are heated from 1100 F to 2350 F in a day-long **average** time of 36.9 minutes. The result—superior quality metal. Average oil consumption is 32 gallons per ton of steel. It will pay you to look into the results you can expect by installing North American for high speed heat release.

Large photo shows 8⅞" billets in 2 of 8 small (36" I.D.) furnaces. Note Burners in right foreground.

Small photo is a close-up view showing burner tiles and flames whipping around a partially forged 10" crankshaft in a large furnace.

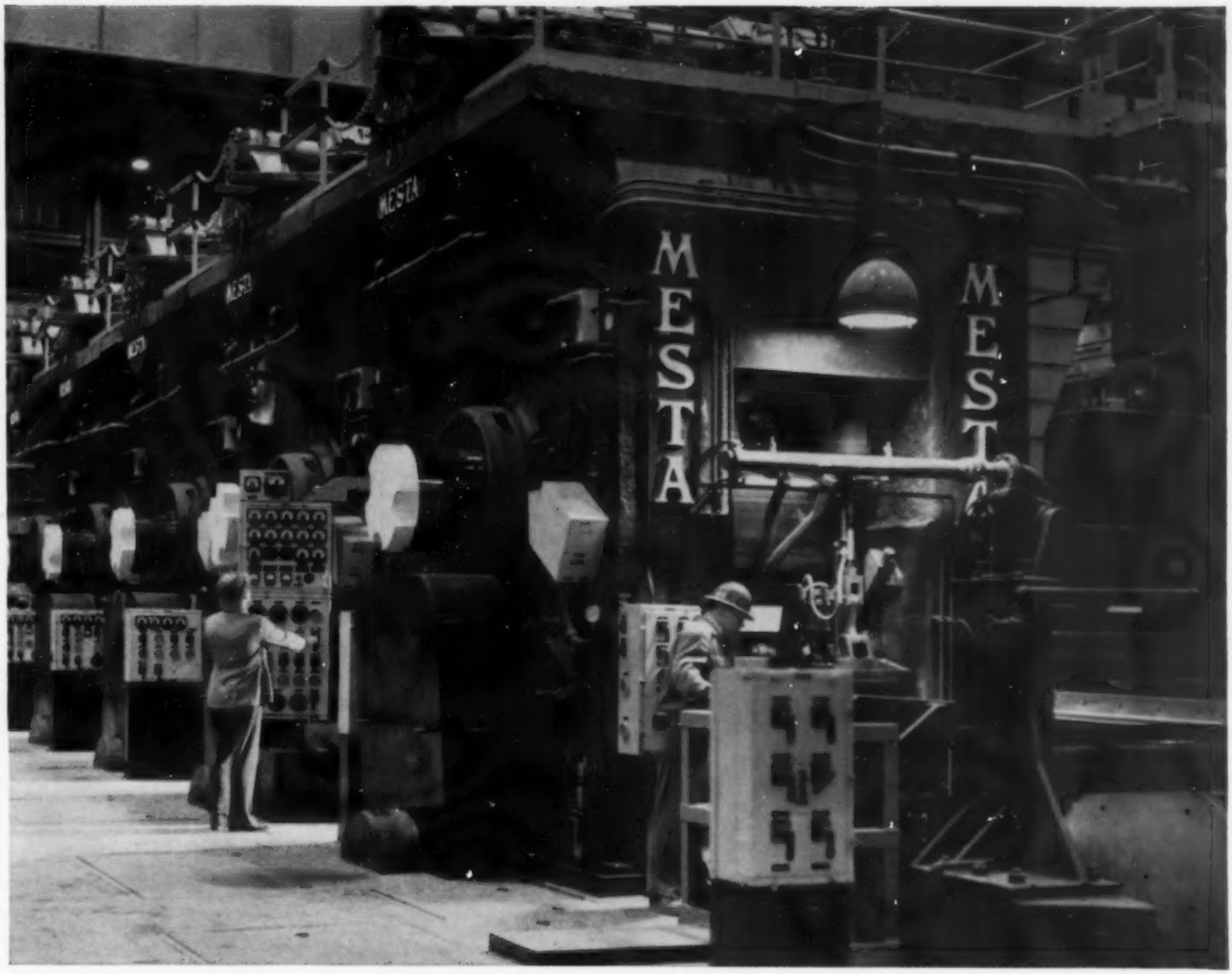
For detailed engineering information, consult your nearby North American combustion specialist. For equipment information, write for bulletin.

NORTH AMERICAN COMBUSTION Since 1917

The **NORTH AMERICAN** Manufacturing Co.

Combustion Engineers

Cleveland 5, Ohio



The back-up roll bearings on this cold reduction mill at U. S. Steel's Fairless Works are protected by Gulf I-C Oil—the oil that maintains its excellent lubricating qualities in rugged service.

tops in protection for back-up roll bearings... GULF I-C OIL!

Gulf I-C Oil has outstanding stability, resists emulsification and sludging, has excellent water separating characteristics. Bearings and oil lines are kept cleaner, when protected by Gulf I-C Oil —and bearings have longer life. Mill performance is more efficient. Maintenance costs are lower.

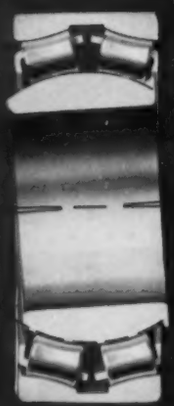
That's why scores of leading mills, like the one pictured here, prefer Gulf I-C Oil for safe, long-lasting lubrication of back-up roll bearings. Next time *you* order, specify the lubricant that contributes to lower cost per ton of steel rolled. Your Gulf Sales Engineer knows exactly which grade of Gulf I-C Oil is best for your operation. Just call your nearest Gulf office.

GULF OIL CORPORATION
GULF REFINING COMPANY
1822 Gulf Building
Pittsburgh 30, Pa.

GULF®

THE FINEST PETROLEUM PRODUCTS FOR ALL YOUR NEEDS

self-aligning . . . CAN'T BIND



HOW SELF-ALIGNMENT WORKS. Spherical inner ring, free to align in any direction, assures full load capacity regardless of shaft deflection or support misalignment.

Husky bearings in husky housings adjust immediately in any direction

When high-impact loads deal out punishment, shaft deflection may spell a quick finish for ordinary bearings. But this rugged Link-Belt bearing is *self*-aligning . . . won't "pinch" or bind when misaligned.

Complete protection is provided by effective seals which block entrance of dirt, escape of lubricant. Durable housing—machined as two perfectly matched parts provides easy installation without shims or alignment rings.

Get full data on Link-Belt's complete bearing line from Book 2550. Ask any of 40 Link-Belt offices or one of our authorized stock-carrying distributors.

Series 6800, 6900, 7800, 7900 roller bearings have internationally standardized boundary dimensions.

LINK BELT

self-aligning ball and roller bearings

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World. 14.44

Maybe you're paying

for top quality "Commercial Grade" Roller Bearings...BUT ARE YOU GETTING THEM?

Cutaway view of Rollway Tru-Rol® segmented-retainer roller bearing ... one of three distinct types of Tru-Rol bearings available.

True, there's a wide difference in quality and cost between the low-range and high-range of any "commercial grade" bearing. But every Rollway Tru-Rol "commercial grade" bearing approximates as closely as possible maximum standards of construction consistent with the price.

Take the matter of separators, for example. In Rollway bearings, separators give maximum guidance to each roller. The result is greater total load capacity and longer life.

Equal spacing of rollers means uniform distribution of load. The result is the elimination of destructive "pulse" and vibration.

Moreover, separators are of deep section, formed to the curve of the rollers, giving true axial alignment, smooth-surface contact and an even lubrication film on each roller.

It's little things like these that mount up to big savings in service. Check the accompanying list, or ask a nearby Rollway Service Engineer to explain in detail the quality you should be getting in your "commercial grade" bearings. No cost. No obligation. Just write us. Rollway Bearing Co., Inc., 586 Seymour St., Syracuse, N. Y., *manufacturers of a complete line of radial and thrust cylindrical roller bearings.*

ENGINEERING OFFICES: SYRACUSE • BOSTON • CHICAGO • DETROIT • TORONTO • PITTSBURGH • CLEVELAND • MILWAUKEE • SEATTLE • HOUSTON • PHILADELPHIA • LOS ANGELES • SAN FRANCISCO

Check This List AND BE SURE!

Retainer Operation

☐ Is the retainer roller-supported, to reduce sliding friction?

Retainer Construction

☐ Is the retainer strong enough to withstand shock loads and sudden reversals?

(A Rollway segmented-type steel retainer, such as that illustrated, is the strongest, most durable available in commercial grade bearings.)

Roller Spacing

☐ Are all rollers equally separated, or do some rub against each other in opposed-motion friction?

☐ Are rollers distributed evenly to prevent "pulse" and vibration?

Roller Construction

☐ Are the rollers crowned for optimum load distribution?

For Top Quality in Every Detail Buy Tru-Rol and Be Sure!

ROLLWAY
Tru-Rol
ROLLER BEARINGS

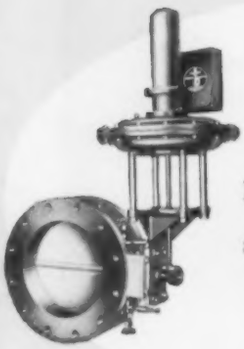
GET THE BEST

Needle Valves

Rugged, outstanding performers for proportional control of small flows. Interchangeable seat rings and plugs. For water, gas, steam, chemicals. Trim and body materials available for "difficult" fluids. Shown here with unique *reversible* Stabilflo Motor.

Saunders Type Valves

A complete line, particularly suited to handling of highly corrosive fluids, or fluids containing solids in suspension. Available with Stabilflo Motor as shown, or with Stabiload Cylinder and Power Positioner.

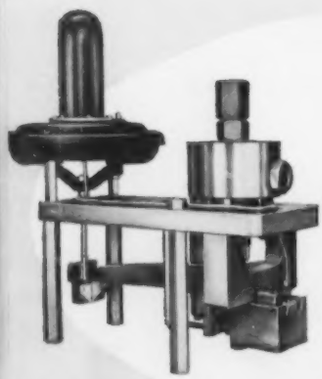


Butterfly Valves

Light and heavy duty types, with angle or swing-through seating, in spool or wafer body style, for low pressure air, gases in combustion control, steam, high pressure gases and liquids, etc. Available with Stabilflo Motor (shown) or cylinder operator.

Gate Valves

Guillotine-type slide valves, specially designed to handle pulp fibre, slurries, and similar fluids. Available with Stabiload Cylinder and Power Positioner as illustrated, for throttling service, or with 4-way pilot valve for on-off service.



Super-Pressure Valves

For throttling or let-down service up to 30,000 psi. Features an exclusive high-pressure bellows seal. Port sizes and connections to meet high pressure process specifications.

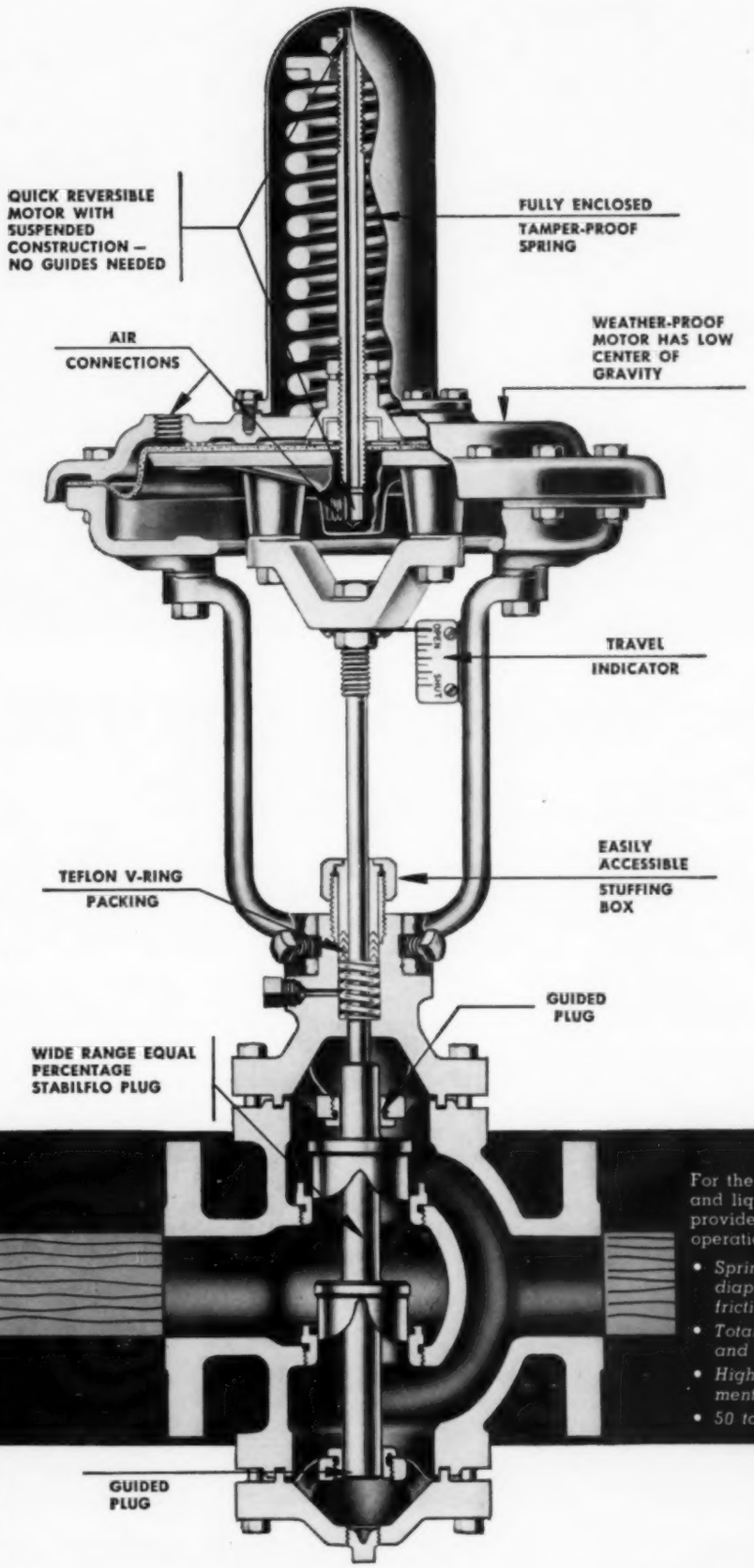
FOXBORO CONTROL VALVES

Reg. U.S. Pat. Off.

8 Strategic Branch Shops for Coast-to-Coast Service: **Pittsburgh, Pa. • Chicago (Skokie), Ill. • Dallas, Tex. • Houston, Tex. • San Francisco (San Leandro), Cal. • Los Angeles, Cal. • Montreal, Que. • Vancouver, B. C.**

SOLUTION TO YOUR CONTROL VALVE PROBLEMS

...with Foxboro Pneumatic Control Valves


QUICK REVERSIBLE MOTOR WITH SUSPENDED CONSTRUCTION — NO GUIDES NEEDED
FULLY ENCLOSED TAMPER-PROOF SPRING
AIR CONNECTIONS
WEATHER-PROOF MOTOR HAS LOW CENTER OF GRAVITY
TRAVEL INDICATOR
EASILY ACCESSIBLE STUFFING BOX
TEFLON V-RING PACKING
GUIDED PLUG
WIDE RANGE EQUAL PERCENTAGE STABILFLO PLUG
GUIDED PLUG

You can always be sure of getting the control valve best suited to flow conditions and control actions when you specify Foxboro. No other single source offers such a wide variety of control valves for specific applications. None other has Foxboro's experience in applying them — in every phase of industrial processing.

Your choice extends from valves for simple on-off control at one extreme, to specialized proportioning control at the other; for high vacuum work to operation at 30,000 psi; for temperatures from −350° to +1000°F. And there's a wide choice of plug designs — and of alloys and trim to handle even severely corrosive and erosive fluids.

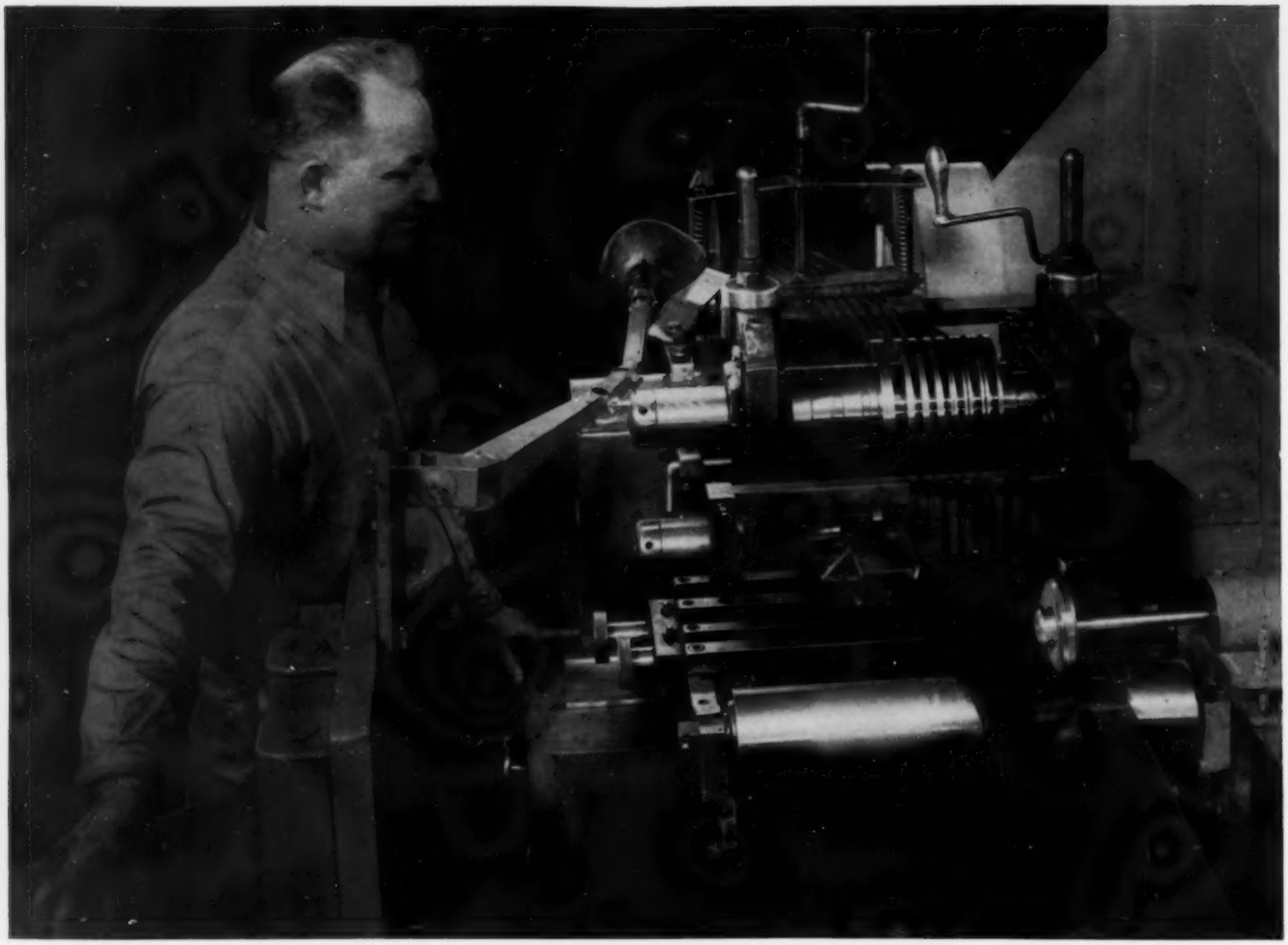
You can save shipping cost and time, too, buying direct from Foxboro's strategically located branch shops. They're staffed by experts.

A few typical control valves from Foxboro's complete line are illustrated here. For full details, or specific information on your problem, call your nearby Foxboro Field Engineer or write The Foxboro Company, 5810 Neponset Ave., Foxboro, Mass.

STABILFLO CONTROL VALVES

For the great majority of temperature, pressure, flow, and liquid level control applications, this basic valve provides unsurpassed sensitivity and troublefree operation. Unique design features:

- *Spring-above-diaphragm construction makes diaphragm motor self-aligning, virtually free from friction and hysteresis.*
- *Totally enclosed spring protects against tampering and corrosion.*
- *High-lift wide range V-port provides greater increment of lift for given change in air pressure.*
- *50 to 1 rangeability - equal percentage characteristics.*



Yoder Slitters Supply Varied Strip Widths for Tinnerman *Speed Nuts*®

Tinnerman Products, Inc., Cleveland, Ohio, produces more than 10,000 different shapes and sizes of "SPEED NUT" brand fasteners for industry . . . many of them to special specifications.

To do this, Tinnerman uses slit steel strands ranging in width from ⅛" to 7½". To carry an inventory of the many strip widths required to meet normal and unusual demands would be almost impossible.

Tinnerman overcomes these inventory and supply problems by doing their own slitting on two Yoder slitters. This enables them to supply the plant with any strip size required from a relatively small inventory of 6" and 9" width purchased coils. In slitting narrow strands, such as these from small coils, a Yoder slitter may be profitable on a production as low as 25 tons per month.

Here is a fine example of how a small investment in Yoder slitting equipment greatly simplifies and speeds production while effecting important operating economies.

The saving made in time alone, reflects in better customer service through faster completion and delivery of finished products.

If your steel strip or sheet slitting requirements are as low as 100 tons per month or even less, a medium size Yoder slitter can be a very profitable investment for you. The Yoder line includes units of every size and capacity . . . of the most advanced engineering design. Send for the Yoder Slitter Book—a comprehensive text on the mechanics and economics of slitters and slitting line operation, with time studies, cost analyses and other valuable data. Write to:

THE YODER COMPANY • 5495 Walworth Ave., Cleveland 2, Ohio

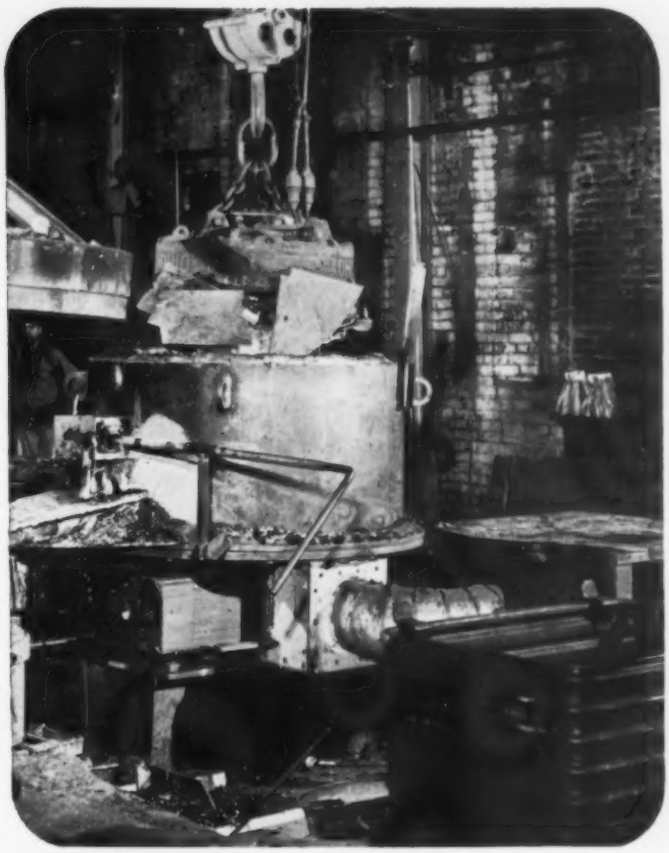
ENGINEERING **YODER** MANUFACTURING

ROTARY SLITTING LINES

PIPE AND TUBE MILLS (ferrous or non-ferrous)

COLD ROLL FORMING MACHINES

5 ways to make your foundry more efficient with OHIO MAGNETS

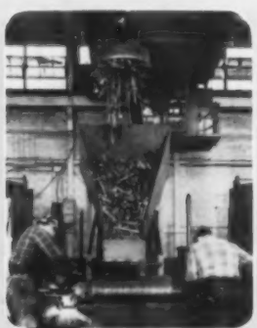


1 CHARGING FURNACE. One 36-inch Ohio Bolted Magnet charges six 375 KW furnaces giving 240 500-pound heats each 24 hours.

2 SCRAP HANDLING. All scrap is handled efficiently, economically with Ohio Magnet. Single 36-inch magnet replaces grapple, clamshell, bucket or lift truck.

3 SORTING. Castings are conveyed from Wheelabrator to hard-iron inspection. Ohio Magnet picks parts out of sorting bins.

4 UNLOADING ANNEALING FURNACE now takes one man 10 to 20 minutes with Ohio Magnet. Lift truck used to take 1 to 2 hours.



5 LOADING GRINDING HOPPER after conveying parts from inspection department. Same Ohio Magnet is used for operations shown in photos 3, 4 and 5.

Photos: Courtesy I-F Manufacturing Company, New Philadelphia, Ohio

ohio ELECTRIC

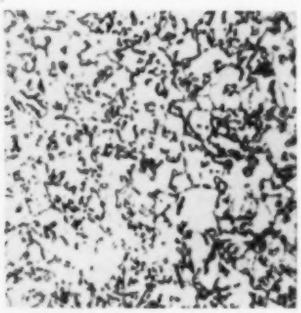
CHESTER BLAND
President

Small foundry or large, magnetic materials handling points the way to higher productivity, higher efficiency. And with Ohio Magnets on the job you get high availability, too. That's because Ohio Magnets are built with that extra margin of safety that means long, service-free life. Yes, *magnetic materials handling pays—especially with Ohio Magnets.*

THE OHIO ELECTRIC MFG. CO.
5400 Dunham Road • Maple Heights • Ohio

AA-5353

carbon-restored steel meets tightest specs



This steel mill easily meets the steadily tightened specifications of customers who demand stock with good surface finish, no "decarb," and uniform microstructures suitable for cold forming and automatic machining.

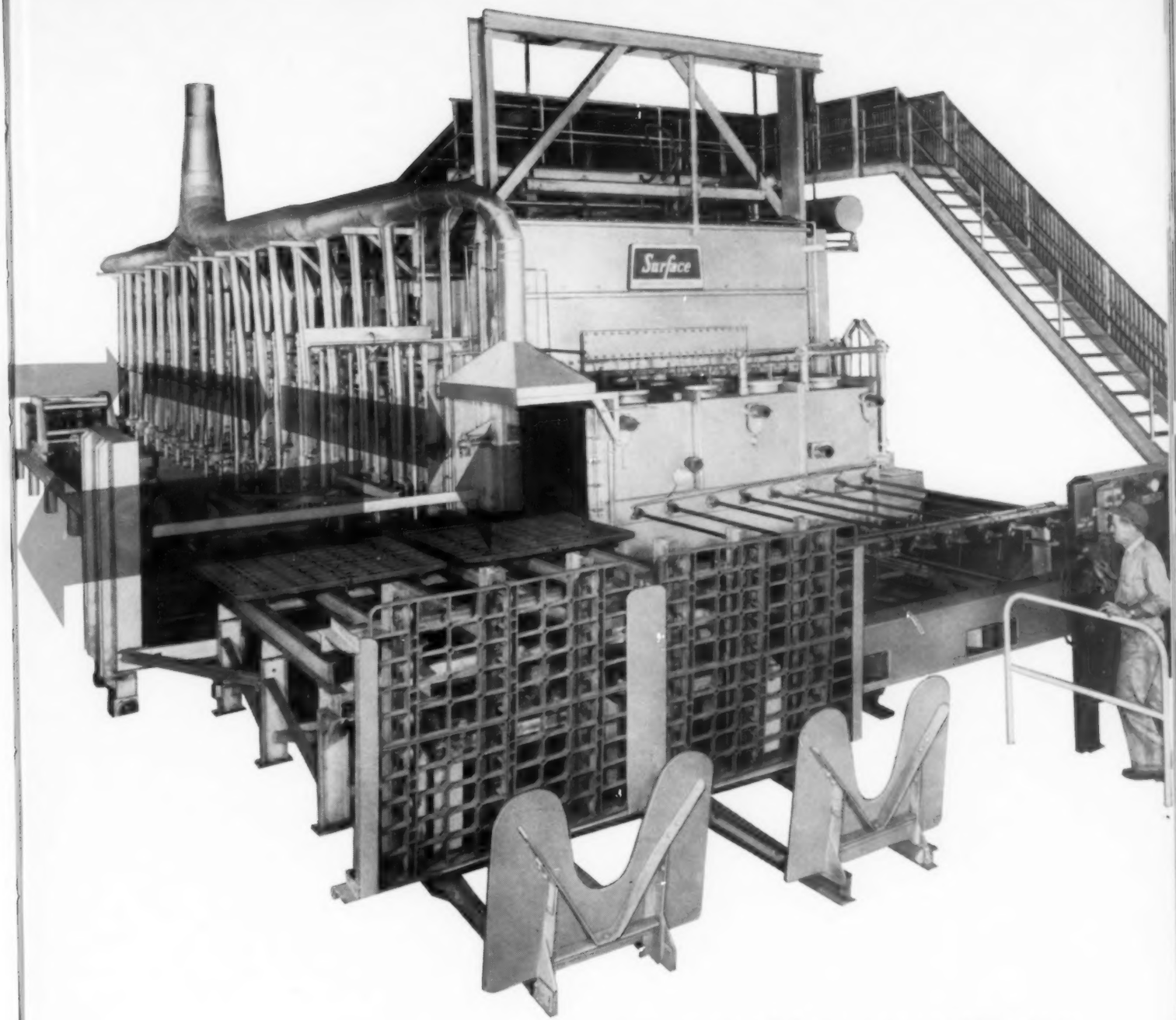
They do it by combining annealing and carbon restoration in a Surface continuous furnace. They get all the flexibility of cycle control they need with 6 zones, individually controlled. An RX® gas generator keeps the carbon potential of the furnace atmosphere in balance with the steels being treated. Automatic dew point recorders provide a continuous check on the atmosphere.

Production rates up to 1,000 tons per month make this furnace a profitable tool.

Again, Surface engineering transforms difficult specifications into profitable opportunities.

Surface Combustion Corporation, 2404 Dorr Street, Toledo 1, Ohio. In Canada: Surface Industrial Furnaces, Ltd., Toronto, Ontario.

ASSOCIATED COMPANIES: British Furnaces, Ltd., Chesterfield • Stein & Atkinson, Ltd., London • Stein & Roubaix, Paris • S. A. Belge, Stein &



you can meet these specifications:

CYCLE ONE (sub-critical anneal)		CYCLE TWO (over-critical anneal)	
STEEL (AISI)	MAXIMUM-BRINELL	STEEL (AISI)	MAXIMUM-BRINELL
4042	160	4037	151
4140	170	4140	174
5140	166	8127	148
8740	170	8740	174

Cycle One production must show spheroidized structure. Cycle Two must show lamellar pearlite structure. Brinell hardness after annealing.

wherever heat is used in industry

Surface®

Roubaix, Bressoux, Liege • S. A. Forni Stein, Genoa • Chugai Ro Kogyo Kaisha, Ltd., Osaka • Benno Schilde Maschinenbau, A. G., Bad Hersfeld

Jos. MARQUÉS.

JULIAN KENNEDY'S *importance to steel making must be measured in millions of tons. When he was born, in the little town of Poland, near Youngstown, Ohio, in 1852, blast furnaces produced only a few tons of iron a day. Before he died he had far advanced the techniques by which one of today's big furnaces produces more than 500,000 tons a year.*

Nor was this all. Julian Kennedy showed the steel industry how to break old precedents, increase production and reduce costs in every phase of mill practice. More than 160 inventions, including blowing and reversing engines, hot blast stoves, blast furnace designs, charging devices, blooming mills and manipulators, poured from his mind. Every mill that he entered prospered — and he was connected with most of the important iron and steel plants in this country. No plant that he ever built failed to make a profit and pay for itself within a few years.

Great Names in Steel Making # VII

The two traits that raised Julian Kennedy to greatness are still living in the men who produce steel ever faster and more efficiently.

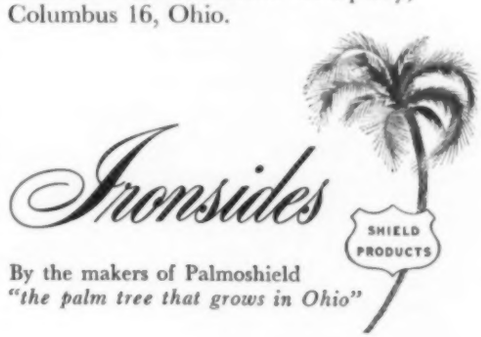
The same impatience with the status quo, and eagerness to apply better products and processes, are seen in the mill superintendents, lubrication engineers and rollers who have recently extended the application of Ironsides' Palmoshield to achieve increased rolling speeds, not only in this country but in overseas mills as well.

This all-American roll lubricant was perfected by Ironsides during the Korean War as the long-sought replacement for imported palm oil. Within six months it was being used or tested in two-thirds of the major mills rolling tin plate. Steel men, appreciating Palmoshield's superior performance, and its availability as a domestic material, have since widened its application to the rolling of light and intermediate gauge sheet, long terne and coating lines as well.

Palmoshield is now proving helpful in the industry's continuing efforts to increase rolling speeds. In test after test "the palm tree that grows in Ohio" has been chosen to lubricate sheet being rolled at sustained speeds in excess of 4,300 fpm.

Palmoshield has all the desirable characteristics of palm oil, plus greater uniformity and the immeasurable advantage of being produced entirely of domestic materials, in the heart of the steel district. Chemical control is so close you can specify fatty acid content to ½%. There is no need for stockpiling. You are never dependent on overseas sources or vulnerable to artificial price fluctuations.

Ironsides engineers compound Palmoshield to suit the mill speed, method of application and individual preferences of each user, and guarantee that this "custom tailored" formula will not vary in uniformity thereafter. A letter or phone call will put their years of experience in successful cooperation with America's major rolling mills at your disposal. Address The Ironsides Company, Columbus 16, Ohio.



By the makers of Palmoshield
"the palm tree that grows in Ohio"

Generator brushes wearing rapidly?

Call your NATIONAL brush man...

TRADE-MARK

Here's how he helped one steel mill increase brush life 400%

FLOYD ANDERSON

Six-month brush life was the most this eastern steel mill could coax out of its 1500 kw generator. The result, reports "National" Carbon Brush Man, Floyd Anderson, was frequent down time plus some mighty expensive *extras*.

Rapid wear, film stripping, threading and grooving resulted in frequent stoning and excessive maintenance cost.

Floyd analyzed the generator's work load and recommended "National" carbon brushes, grade N-4. Brush wear was reduced immediately. N-4 brushes are averaging two years' service on this generator – a 400% improvement.

Floyd Anderson and his fellow "National" Carbon Brush Men have been solving industrial brush problems for years. Their experience and training – backed by "National" *long term brush development*–make them the logical consultants on any industrial brush application.

Call them today or write National Carbon Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

The terms "National", "N" and Shield Device, and "Union Carbide" are registered trade-marks of Union Carbide Corporation

NATIONAL CARBON COMPANY • Division of Union Carbide Corporation • 30 East 42nd Street, New York 17, N. Y.

UNION CARBIDE

Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco. *In Canada:* Union Carbide Canada Limited, Toronto.

You are looking at a high-production tool!

Overhead cranes in steel mills must provide steady service and speedy handling of materials to maintain a smooth flow of production. And you get *more* of both with P&H "mill-type" overhead cranes . . . rugged units that are engineered mechanically, structurally, and electrically to provide uninterrupted duty cycles in steel mill service.

P&H cranes are built to enable operators to lift and move giant loads quickly . . . to spot them accurately and safely with finger-tip ease. The results: top performance, less wear and maintenance, and uninterrupted material flow.

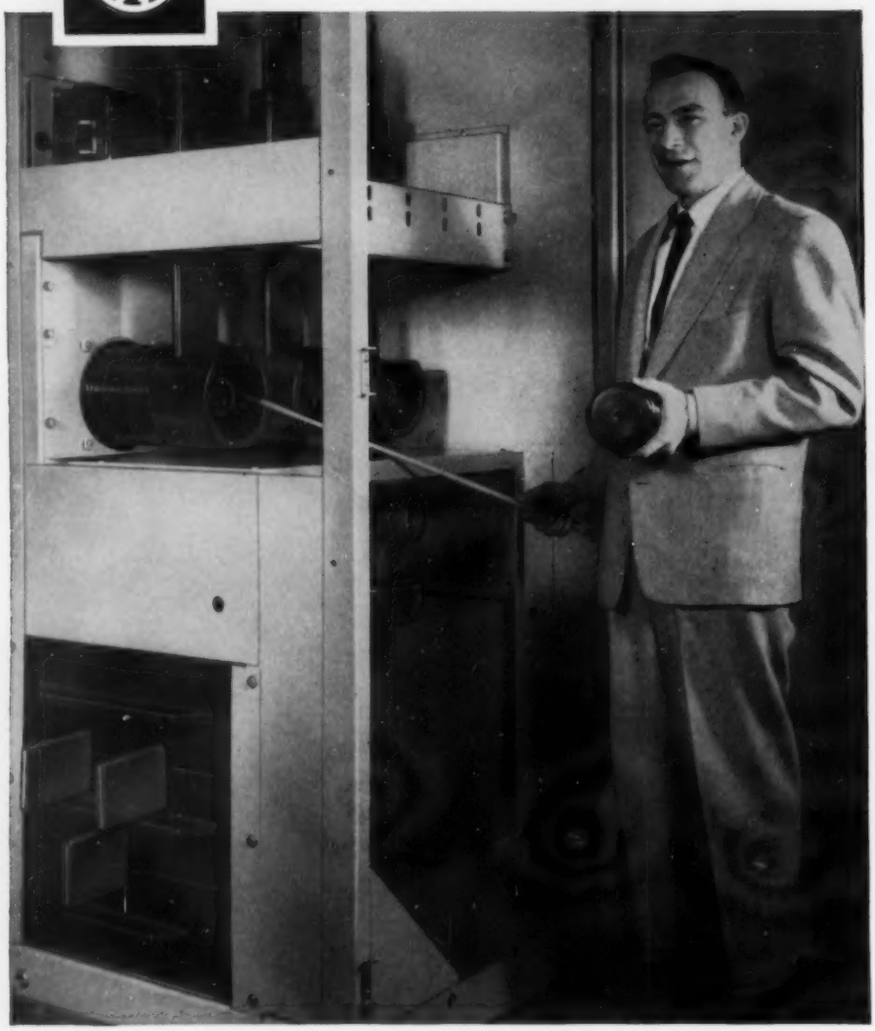
Remember, too . . . P&H designs and builds all the parts for P&H cranes and provides service by skilled technicians wherever, whenever needed.

You know you can rely on P&H experience, engineering, and advanced overhead crane design. Thus it is wise to consult P&H first. For more information write Dept. 131G, Harnischfeger Corporation, Milwaukee 46, Wisconsin.

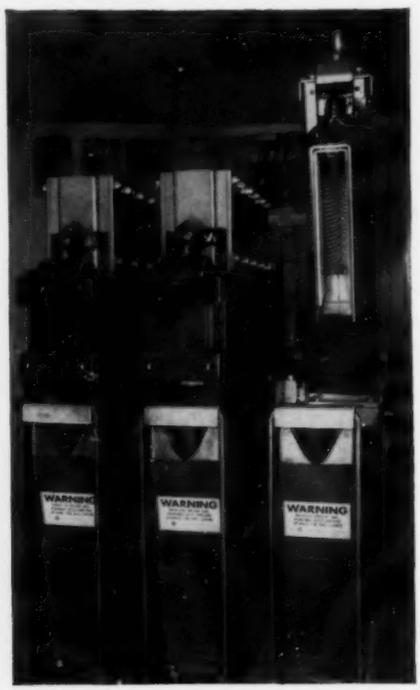
HARNISCHFEGER

P&H ...quality and service for 73 years

METAL-CLAD SWITCHGEAR



PURIFIED PORCELAIN in horizontal and vertical bus supports, primary disconnect bushings and caps and epoxy in bus joint covers provide excellent insulation, prevent fires in 15 kv I-T-E metal-clad switchgear.



EPOXY AND SPECIAL CERAMICS protect personnel and equipment by preventing fires in the circuit breaker section. Arc chute rear supports and blowout coils are epoxy. Jump gap cooling plates, arc chute liner plates, arc plates and spacers are special ceramics.

Only the finest fire-protective insulating materials

Nonflammable porcelain and ceramics, flame-resistant epoxy, and other flame-retardant insulating materials throughout, are among the extra values you find in I-T-E Metal-Clad Switchgear. Purified porcelain, of which the primary disconnect bushings and caps are made, also supports both vertical and horizontal bus. It is nonflammable, has high dielectric strength, won't track or deteriorate, is inherently contamination free.

Epoxy, which can be molded into complicated shapes, forms arc chute rear supports, blowout coils, bus joint covers, potential and current transformers. It has high mechanical and dielectric strength, is nontracking and extremely flame resistant.

Special ceramics, highly resistant to direct arc exposure, are used in jump gap cooling plates, arc chute liner plates, arc plates and spacers. These have high dielectric strength, low moisture absorption, won't track, are excellent interrupting materials. They do not deteriorate when subjected to direct arc exposure. They absorb thermal shock and deionize gases without excessive heating.

Phenolic and polyester insulating sheets and moldings, specially treated to provide the highest possible degree of flame-retardant characteristics, are also used.

If you are planning new construction or modernization requiring electric power, consider the advantages of I-T-E equipment. Consult your local I-T-E sales office or write I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division

IN CANADA: EASTERN POWER DEVICES, LTD.

DREVER

Plate

Heat Treating Line

Shown is the charging end of a 145'-0" hardening furnace. In the background can be seen a 2500 ton pressure quench, 200'-0" draw furnace and the operator's control pulpit.

This roller-hearth plate heat treating line, known to be the largest of its type, has a capacity to treat plate up to 21-1/2 tons per hour. The equipment is capable of handling plate sizes up to 172" wide x 3" thick x 600" long.

The furnace rolls are 25/12 modified alloy and are designed for a maximum furnace operating temperature of 1650° F.

The maximum fuel capacity for both furnaces is 122,000,000 Btu's per hour.

The entire line is under the control of a single operator. Full utilization of strategically located TV cameras enables the operator to have full control over all operations.

DREVER COMPANY

RED-LION ROAD and PHILMONT AVE., BETHAYRES, PA

Westinghouse offers: the only self-adjusting

D-C magnetic brake

Simplicity of construction— minimum number of parts means years of trouble-free operation

Now, brake adjustment problems are gone forever. With Westinghouse exclusive self-adjusting d-c magnetic brakes, the need for adjustment is eliminated—for the life of the brake lining.

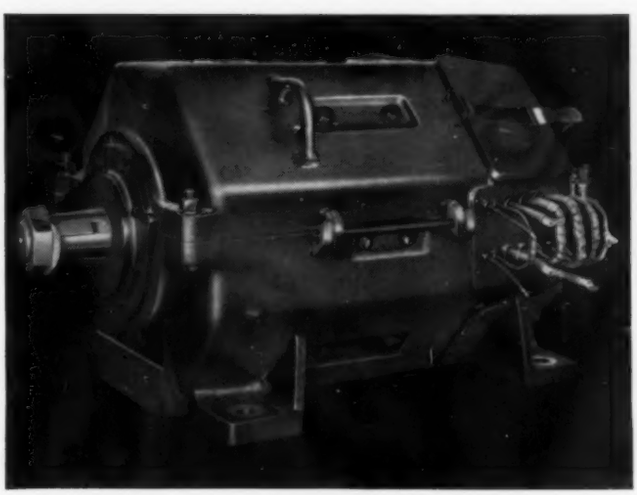
Regardless of lining wear—or wheel expansion—the SA brake shoe is always in correct adjustment and proper alignment.

Field tests show self-alignment of SA brakes permits even lining wear—shoe tips cannot drag. Lining life is increased up to 50%. Wheel wear and scoring are minimized for longer wheel life.

For complete information on industry's most advanced d-c magnetic brake, call your WESTINGHOUSE sales engineer. Or, write Westinghouse Electric Corporation, 3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pennsylvania. Ask for B-6547.

J-22048

YOU CAN BE SURE...IF IT'S Westinghouse



Westinghouse mill motors with silicone insulation

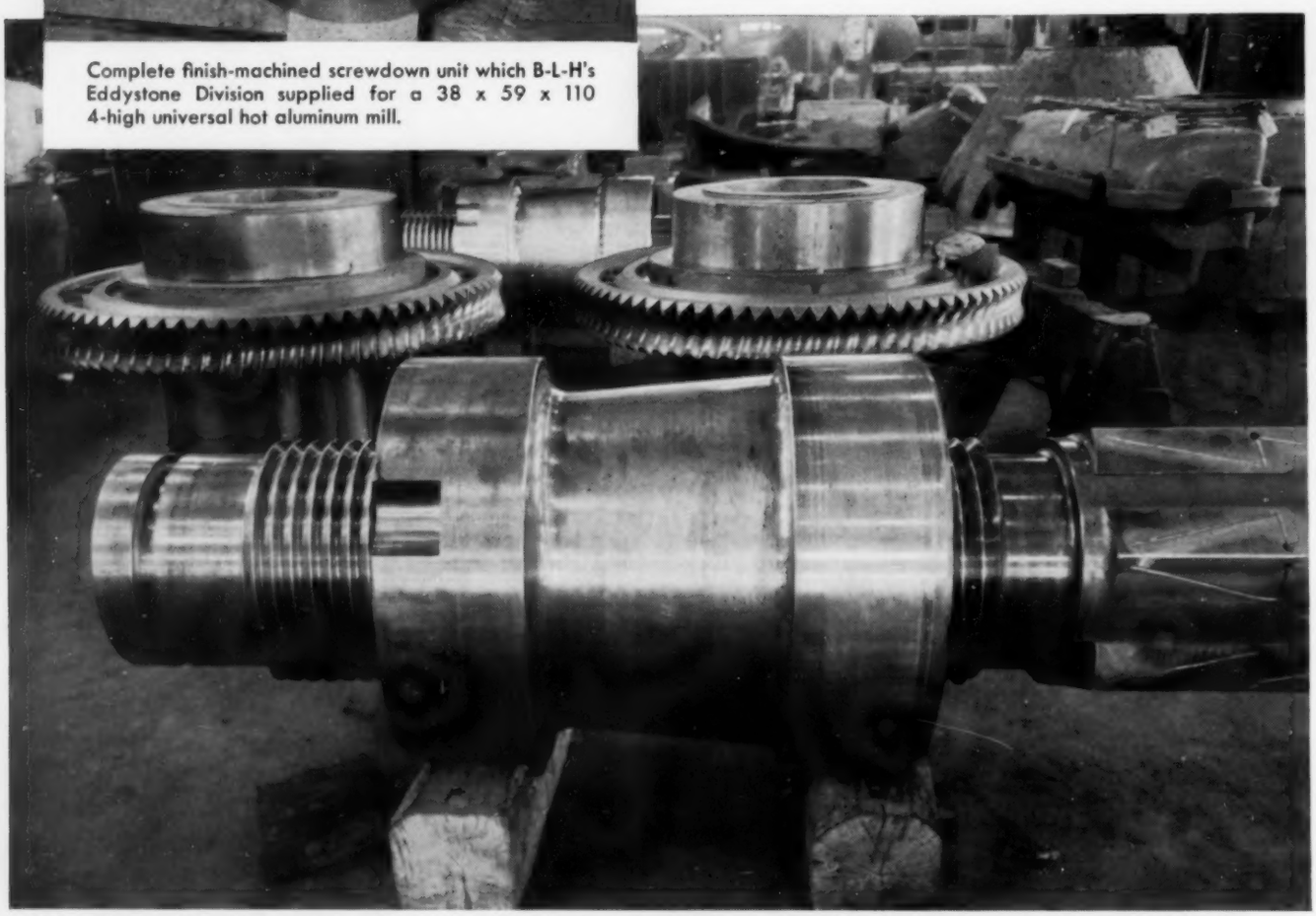
are giving top performance on the toughest applications. Silicone insulation plus greater capacity and cooler operation of improved field coil design . . . heavy-duty shaft, bearing and housing design to take high torque loads . . . give you longer, more dependable motor life with Westinghouse Hevi-duty Mill Motors. For all the details, ask for B-6547.

Whether you need the complete finish-machined unit or simply rough castings or forgings, look to Baldwin

Complete finish-machined screwdown unit which B-L-H's Eddystone Division supplied for a 38 x 59 x 110 4-high universal hot aluminum mill.

Baldwin's facilities are vast, its output varied. In some cases you may want only the rough castings or forgings. In others you may want the complete finish-machined unit. In any event you'll find that whatever your particular job demands, Baldwin can meet your needs . . . and often increase the service life of wearing parts by proper metal application.

Baldwin offers you fully staffed engineering and metallurgical departments and the most modern of chemical and physics laboratories. Equipment includes spectroscope, electron microscope, and X-ray machines, for both research and quality control. Machine tools run from small lathes to 42-ft. boring mills. These facilities, together with the skills of our experienced people, can help you. Write today for our illustrated Foundry Bulletin 6002.



Screwdown unit housing nut cast at Eddystone of Cramp Superstrength Bronze, an alloy with ultimate tensile strength of 90,000 psi.

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Eddystone Division

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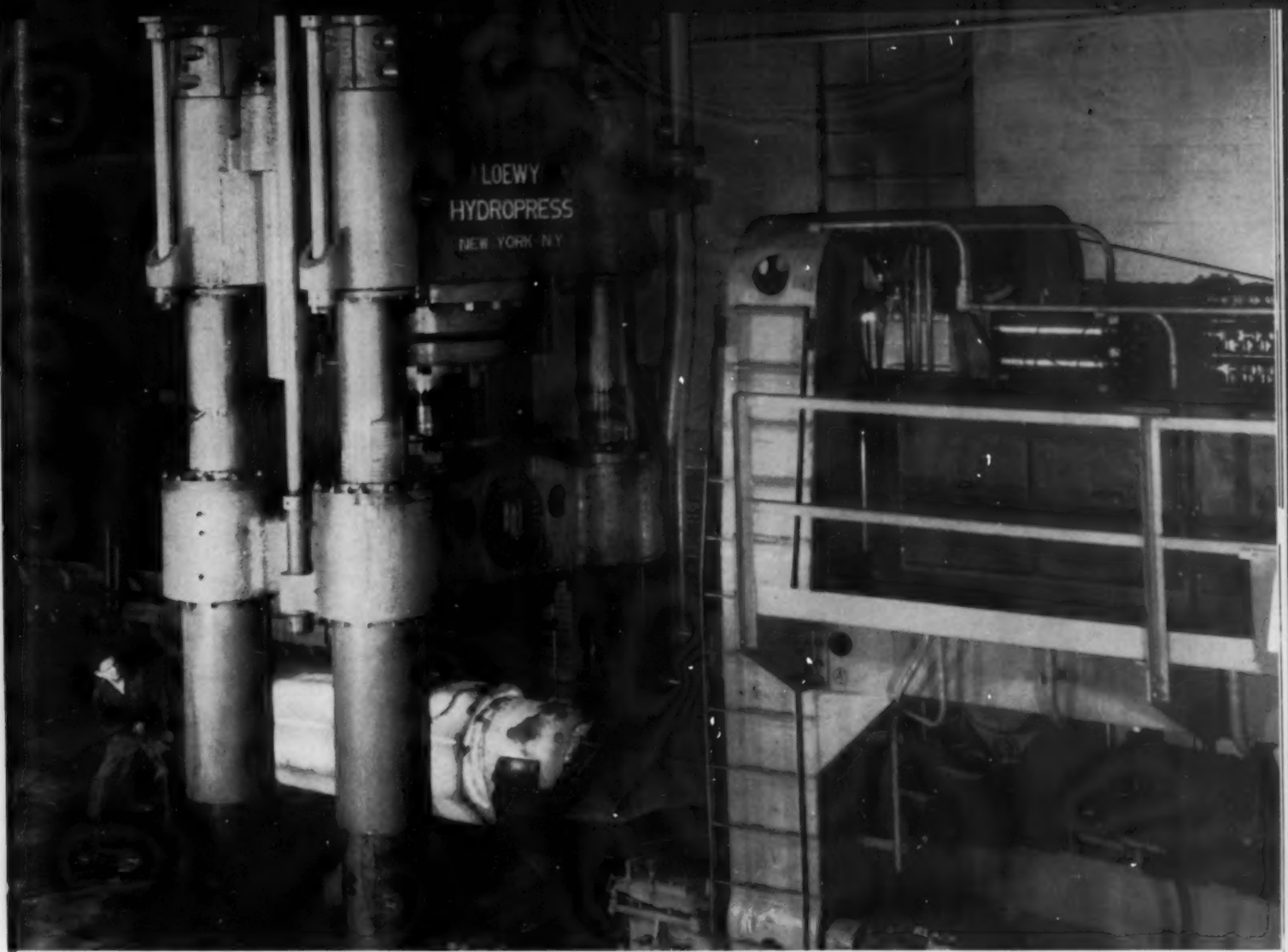
Hydraulic turbines • Weldments • Dump cars • Nonferrous castings • Special machinery • Bending rolls • Machine tools



Loewy-Hydropress fast-acting 2000 ton hydraulic forging press in operation at Universal-Cyclops Steel Corporation.

"This fast-acting 2000 ton hydraulic forging press imparts to special steels internal qualities never before achieved"

That's the conclusion of Universal-Cyclops Steel Corporation, a major producer of specialty steels since 1884, as to its Loewy water-hydraulic forging press.

Driven by air-loaded accumulator and equipped with oil-hydraulic effortless servo controls for both normal forging and planishing, this press was designed for extreme eccentric loading and highly economical production—like all Loewy-Hydropress equipment. Note the oversize columns, which have no reduction in area at points of maximum flexure. Due to faster displacement of metal and fewer reheats, Loewy high-speed open forging presses can outproduce hammers in working specialty alloy steels.

Loewy designs and builds open and closed die forging presses, Marform rubber-pad deep drawing presses, extrusion presses, rolling mills, and any other special machinery for hot and cold forming of steel and nonferrous metals. And because Loewy has at its disposal the vast, smoothly integrated facilities of the entire Baldwin-Lima-Hamilton Corporation, you are assured of delivery on time.

For specific information, write Dept. C-10.

Loewy-Hydropress Division

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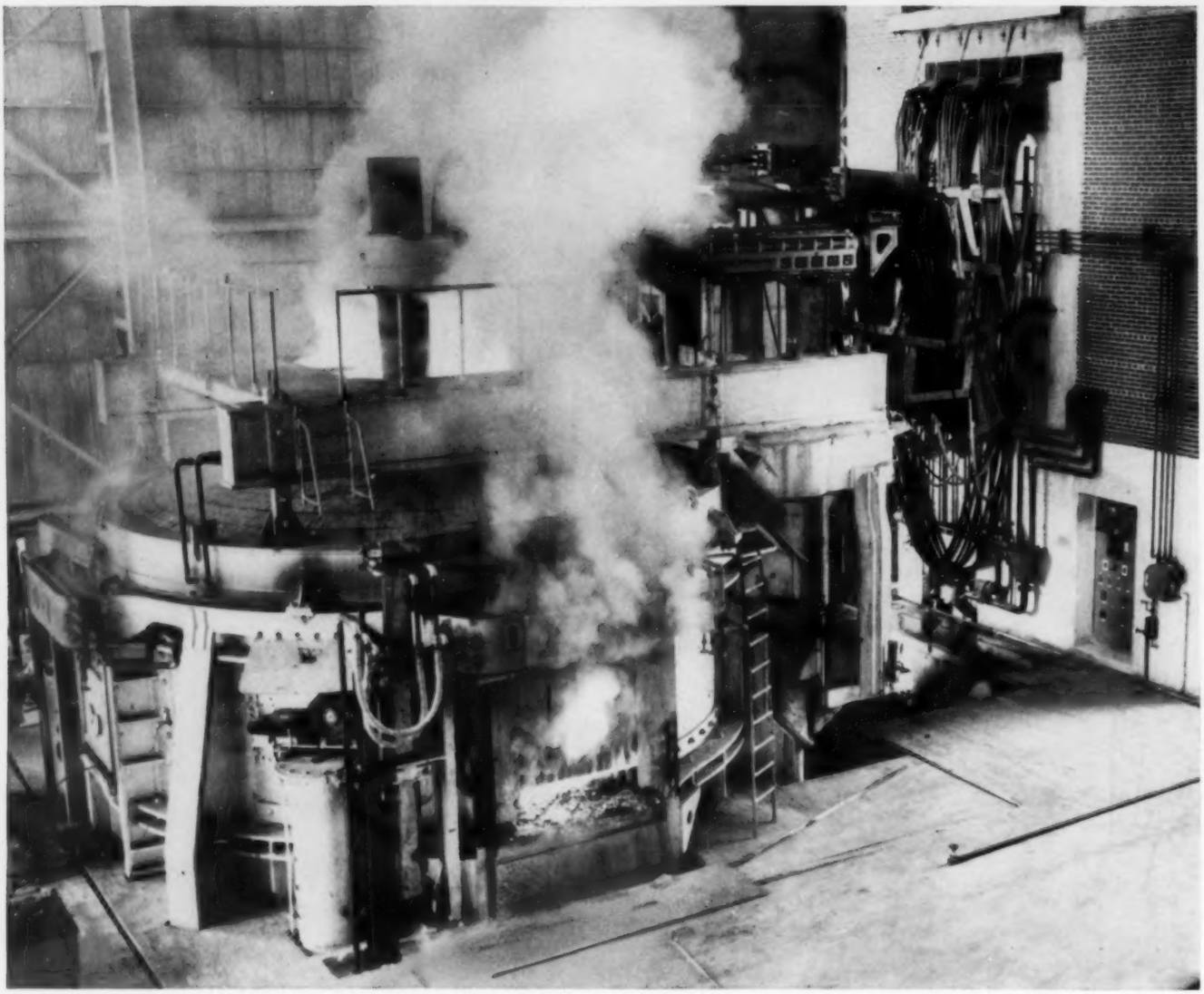

200-ton heats for 24-foot Lectromelt Furnace in Southern steel plant

First of two 24-foot Lectromelt furnaces installed to expand metal making facilities in a Southern steel plant. Present heats run 180 tons . . . 200-ton heats planned in the near future.

Lectromelt®

Catalog 9-B describes Lectromelt Furnace equipment. For a copy, write Lectromelt Furnace Division, McGraw-Edison Company, 310 32nd Street, Pittsburgh 30, Pennsylvania.

. . . . Algoma's combination mill has been ingeniously designed to use interchangeable stands on the same mill shoes and on the same pass line . . . . operating results have been good and the mill is extremely flexible . . . .

Algoma's Combination Bar and Strip Mill

By
W. H. MULFLUR
Division Superintendent
Algoma Steel Corp., Ltd.
Sault Ste. Marie
Ontario, Canada

▲ ALGOMA'S 30-in. combination bar and strip mill was put into operation at the end of 1952. The basic reason for the combination features of the mill was to develop in a limited market a flexible operation capable of economically producing quality hot-rolled sheets, strip, skelp, plate and merchant bars. With an eye to the future, provisions were made to expand the operation by splitting off as a separate operation the merchant bar part of the mill. Thus it was expected to maintain full utilization of the equipment until the normal economic growth of Canada and other allied operations in the plant would support both a modern hot strip mill and a modern merchant mill.

The mill is unique in several respects. As a hot rolled flat product mill, it consists of eleven horizontal stands and five edgers, with the attendant twist trough, vertical coilers, hot flying shears and piler as well as a plate run-out line and shear. As a merchant bar operation it consists of thirteen horizontal stands and five edgers, with the attendant repeaters, rotary shears, hot beds and Q-bar shears. There is also a broadside table and a skew-y table for heavier sections that cannot be repeated. Figure 1 is a plot plan showing the layout of the mill.

Flexibility and simplicity of technique have been accentuated. The time necessary to accomplish a change from flat-rolled product to merchant bar product is only eight hours. Without sacrificing mill performance or product quality, many parts of the mill are of dual purpose design and a tribute to the resourceful imagination of the designers.

Perhaps it would be well to consider first the product range and requirements of this dual purpose mill. At the outset it was felt that the mill would need a potential capacity of approximately 20,000 tons per month, divided between hot-rolled strip, skelp for both continuous butt-weld and electric-weld pipe, narrow sheets, and small merchant bar sections such as rounds, flats, squares, reinforcing bars and angles.

Currently the mill rolls the following products:

As a merchant mill

Rounds $\frac{1}{2}$ to $2\frac{5}{16}$ in. diam.
Squares and ferro-concrete bars of equivalent section.
Angles $1\frac{1}{2}$ x $1\frac{1}{2}$ in. to 3 x 3 in., from $\frac{1}{8}$ to $\frac{1}{2}$ in. thick.
Uneven leg angles equivalent to even leg angles up to $3\frac{1}{2}$ x $2\frac{1}{2}$ in.
Flats up to 4 in. wide, up to 1 in. thick.

As a flat-rolled operation

Flats and plates 4 to 25 in. wide up to 0.750 in thick.
Hot-rolled coils: 0.085 to 0.375 in., from 4 to 26 in. wide.
0.060 in. to 24 in. wide
0.047 in. to 20 in. wide

In addition to the above products, the mill is capable of rolling the following standard sections:

Channels—2 to 3 in.
Beams—3 in. high
Tees—2 x 2 x $\frac{1}{2}$ in. to $2\frac{1}{2}$ x $2\frac{1}{2}$ x $\frac{3}{8}$ in.

Up until the present time the utilization of the equipment has been at such a high peak that further expansion of products has not been warranted.

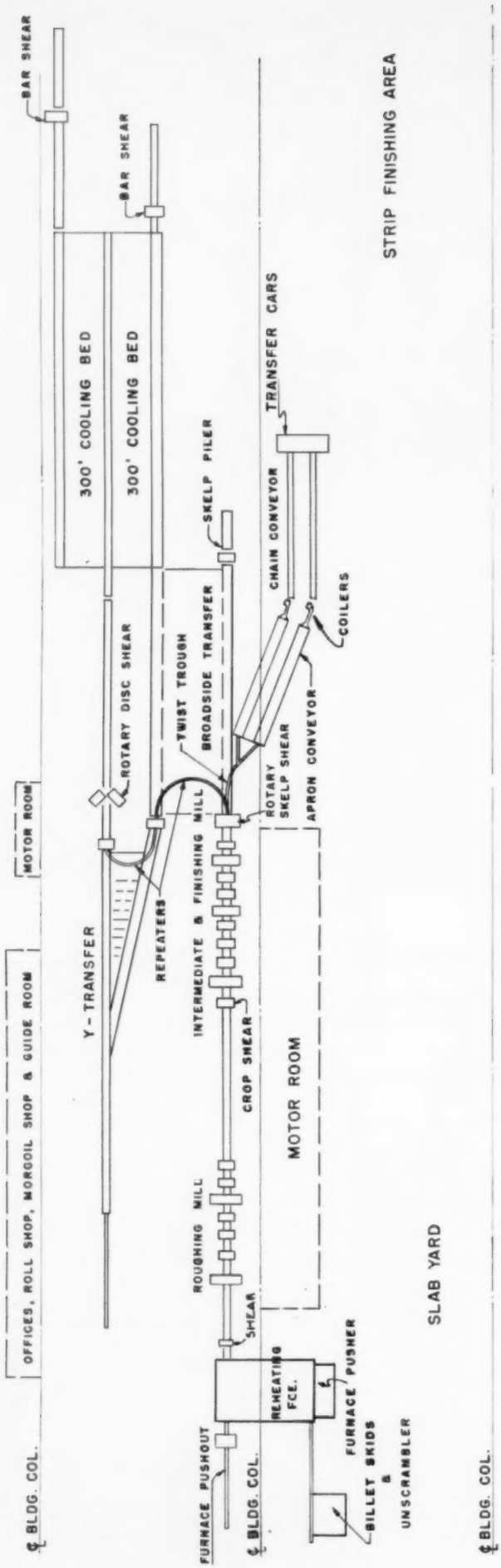

Figure 1 — Layout of Algoma's combination bar and strip mill.

Figure 2 — Furnace is charged by a ram type car driven by two heavy duty roller chains.

SLAB AND BILLET CHARGING

Since the mill rolls both merchant bars and hot-rolled flat product, provisions were made to handle both slabs and billets. A regular billet unscrambler with a hydraulic turnover works equally well with billets or slabs up to 27 in. wide. Magnet cranes place the conditioned slabs on the unscrambler, which is equipped with both movable and stationary skids. The slabs are then deposited by the unscrambler onto the furnace charging table rollers, where it is possible, if so desired, to turn slabs over or discard them for return to the slab yard. The charging table, which is approximately 80 ft long, is the standard type equipped with bevel gears fully enclosed and with splash lubrication. Charging into the furnace from the table is accomplished by a ram-type car mounted on rails over the table and actuated by two heavy-duty roller chains, from a drive located at the end of the table (Figure 2).

REHEATING FURNACE

Originally the reheating furnace was a two-zone operation, with side charge and discharge, 33 ft inside by 55 ft effective length, with a sloping hearth, capable of handling 30 ft 6 in. slabs at a rated capacity of 80 tons per hour. However, after the mill had been in operation but a short time, it became increasingly apparent that the mill rolling rate on some sections would be seriously restricted by the furnace. Accordingly plans were made to increase the heating capacity by the installation of a third bank of bottom-fired burners, with water-cooled longitudinal skid pipes, cross skids and risers typical of the modern strip mill slab reheating furnace. The change was accomplished with a 14-day down period. While the effective hearth area was not enlarged, the third bank of burners resulted in an increase in heating capacity amounting to 35 tons per hour. Fuel is either coke oven gas or oil or both, depending on the availability of coke oven gas in the plant.

The fuel rate for the original two-zone furnace was approximately 1,650,000 Btu per ton. Since the installation of the third bank of burners and water-cooled skid pipes, the fuel rate has increased approximately 15 per cent. The furnace is not equipped with recuperators.

One problem introduced by the furnace changeover was the spotting of many random length billets and slabs on skid pipes with relatively wide spacings. Since in double-row charging, billet and slab lengths may vary from 11 to 15 ft and single-row billets may vary from 21 ft to 30 ft 6 in., the problem of spotting a wide assortment of slab lengths by a side-charge operator located approximately 60 ft from the furnace became almost impossible.

Considerable study was given to working out, for the various slab lengths, a series of limit switches which could be pre-selected and which would stop the charging car in the correct position for each slab. However, because poorly spotted slabs with sharply bent ends might further sag when heated and become fouled on the water-cooled cross skids, it was finally decided that the safest procedure was to spot by manual direction. The idea of using television to enable the charging operator to see the field of action was proposed, but was finally shelved because the number of positions to be checked would require at least four cameras. Until something better is worked out, the problem is being solved by a "spotter." This is the only increase in force as a result of the furnace change.

The slabs or billets, after traveling down the length of the sloping water-cooled skids to the bridge wall, move on to a ceramic hearth of plastic. To date there have been over 500,000 tons of steel pushed over this hearth with just minor repairs. As a matter of fact, the most serious repair was as a result of an over-enthusiastic workman digging a hole in the hearth while cleaning cinder.

As might be expected, the installation of the lower bank of burners, together with the higher firing rate, has resulted in an increase of cinder or slag on the hearth with the attendant and never-ending slab pile ups. Cleaning a 33-ft wide hearth covered with 27-in. slabs 30 ft long, weighing up to 11,000 lb, provides a need for big men with strong backs. This problem was particularly difficult because of the restricted working area on both sides of the furnace which makes the use of peel bars through the side doors just plain hard work.

The use of the "clean-out slab" or "plow" commonly adapted to most of the hot strip mills for cleaning furnace hearths is impossible because of the very restricted size of the charging and discharge equipment. Furthermore, the furnace charging and discharge doors are much too small for a "clean-out slab." However, necessity is the mother of invention and the problem was worked out as follows:

When the heater feels that the hearth should be cleaned, he orders the slab yard to charge "dummy slabs." These dummy or scrap slabs each have square holes 6 x 15 in. at the two ends and mid-length. When these dummy slabs reach the cinder-covered hearth, a small bulkhead in the front wall of the furnace below the burners is opened. In the meantime an 8-ton ram

Figure 3 — Ingenious application of a lift truck is used in dragging billets when cleaning hearth of furnace.

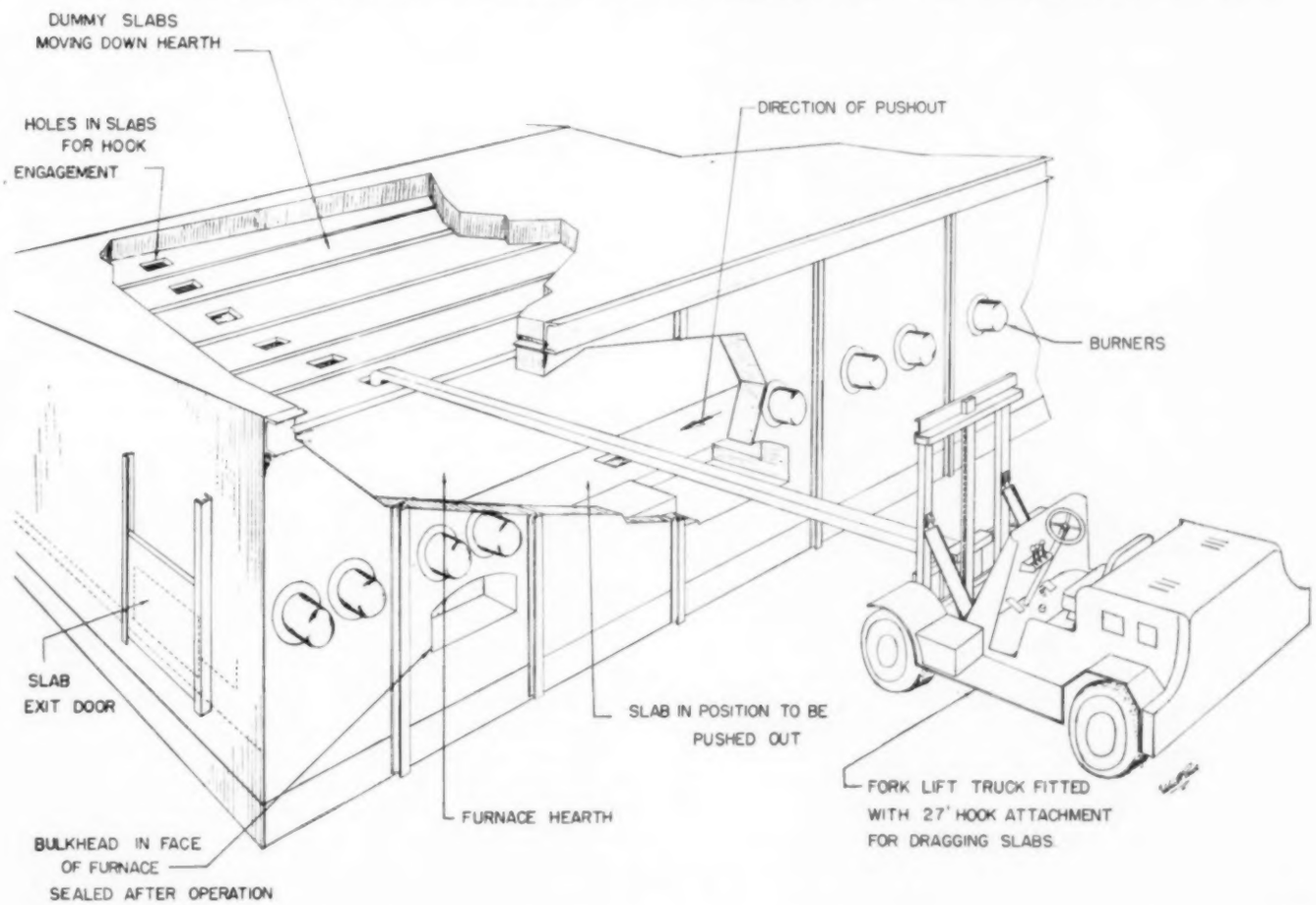
DUMMY SLABS MOVING DOWN HEARTH
HOLES IN SLABS FOR HOOK ENGAGEMENT
DIRECTION OF PUSHOUT
BURNERS
SLAB EXIT DOOR
SLAB IN POSITION TO BE PUSHED OUT
FORK LIFT TRUCK FITTED WITH 27' HOOK ATTACHMENT FOR DRAGGING SLABS
FURNACE HEARTH
BULKHEAD IN FACE OF FURNACE SEALED AFTER OPERATION

Figure 4 — Main drive motors are 600-volt, d-c machines.

tractor has been brought to the furnace area. The coil ram is removed and replaced with a 27-ft, 3 x 3-in. billet ram fitted with an adapter for the tractor hoist. The tractor driver then runs the 3 x 3-in. billet with a right-angle hook on the end through the open bulkhead. The hook on the end of the billet is used to catch the square hole of the dummy slab. By backing up, the tractor driver is able to pull the dummy slabs down the furnace hearth where they can be pushed out the same as any rolling slab. (Figure 3 shows a sketch of this operation.) By close co-operation and planning, it is possible to remove all dummy slabs from the hearth in less than fifteen minutes. Scheduling hearth cleaning during a roll change has reduced delays to a minimum.

The furnace is equipped with automatic firing rate controls actuated by target tubes in the soaking zone and heating zone roofs, as well as automatic fuel-air ratio controls.

There is a combination scalebreaker and pull-out roll adjacent to the discharge door of the furnace. This pull-out roll can also be used to put a prematurely discharged slab back in the furnace.

Between the furnace and the roughing train there is an up and down parting shear capable of shearing any slab or billet rolled on the mill. At times this shear is used to cut a trial bar from a 30-ft billet or slab. The remaining portion of the billet can be pushed back into the furnace by use of the above-mentioned furnace pull-out roll.

MOTORS AND DRIVES

Table I is the bar and strip mill data sheet, showing the rolling stands, roll sizes, type of roll bearings, size of rolls and spacing between the mills, together with the hp, motor speeds, gear reduction ratio and fpm of each mill.

The main drive motors are 600-v, d-c machines, which take their power from two 4-unit synchronous motor-generator sets. Each set is comprised of one 7000-hp, 11,000-v motor; two 2500-kw, 600-v, d-c generators, and one 150-kw overhung exciter.

The 600-v, d-c control incorporates three high-speed bus tie, air-circuit breakers—two of these breakers are used for short circuit protection only, while the third permits the mill train to operate on either single or split bus. When operating on split bus, all drives up to and including No. 4 edger, of the intermediate train are fed from No. 1, No. 2 and No. 3 generators, while the remaining three stands on the intermediate mill, No. 5 edger, and the two looping stands are powered by No. 4 generator.

The ventilating equipment for the main drive machines and the motor-generator sets is of the down-draft recirculating type and is designed to remove the full load losses of the machines. Equipment to provide a supply of filtered make-up air is also in use.

A 2000-kva, 550-v, a-c substation and a 1500-kw, 250-v d-c substation supply power to the auxiliary equipment in the mill.

Figure 4 shows a section of the motor room.

ROLLING MILL

The continuous roughing train common to both merchant bar and flat rolling consists of five 2-high, 30-in. horizontal stands and two edgers. No. 1 vertical scale breaker with 24-in. rolls precedes No. 0 horizontal 2-high stand. No. 2 edger with 16-in. rolls is located between No. 2 and No. 3 horizontal stands. The five horizontal stands with a nominal work-roll diameter of 22 in. are capable of reducing 25 x 5⅛ in. slabs to 1 in. Since as a rule the minimum slab thickness is maintained at 3 in., the full range of slab sizes for flat-rolled product can be rolled on two roughing mill setups. The following shows the bar thickness out of each roughing mill stand for slabs 4½ in. and heavier and slabs under 4½ in.

Thickness out of each stand in in.

Stand no.	0	1	2	3	4
Slabs 4½ in. and heavier	3.875	2.750	1.813	1.375	1.00
Slabs lighter than 4½ in.	2.875	1.875	1.375	1.00	0.750

In order to save time that might be lost making manual screwdown changes for the two roughing mill setups, each stand is equipped with two breaker block fillers machined to the exact amount of screw-down change to be made for each mill. Thus the rougher merely drops the roll balance, inserts or removes the machined fillers as required, and raises the roll balance without touching the screwdowns. Furthermore, when rolling plate, No. 4 stand is dummied in the same manner, again without touching the screwdown.

At one time it was proposed that the roughing mill screwdowns be power driven, but the foregoing practice has eliminated any need for this expenditure. Thus, when rolling strip, the manually-operated screwdowns are in effect used only to keep the mill level and seldom for section changes. The roughing mill is also equipped with 1200-psi hydraulic descalers following the No. 1 vertical scalebreaker and No. 3 horizontal stand.

Since slabs weighing up to 500 lb per in. of width are rolled, and since the distance between No. 4 stand and No. 3 edger is 144 ft-6 in., there are many sections where the bar is simultaneously in the roughing and finishing trains. Because of the danger of an undetected pull on the delay table, the roughing train is run slightly faster than the finishing train. In this manner

Figure 5 — The roughing train is run slightly faster than the finishing train.

Figure 6 — Finishing train consists of six four-high stands.

the bar is looped on the delay table. The formation of the loop is controlled by a "hump table," which starts the loop in the same place on every bar. Figure 5 shows how the loop is formed and controlled on the delay table.

A crop shear is installed in the delay table approximately 20 ft ahead of No. 3 edger. The crop shear knives have a 44-in. radius and are used to crop the product of the roughing mill before entry into the finishing train. The radius on the crop shear knives produces a leading end on the bar, which results in a minimum of cobbles and a greatly reduced impact as the head end of the bar hits each successive stand.

The 6-stand, 4-high continuous finishing train with descaling sprays, loopers and guide boxes, is typical of most finishing trains found in the modern strip mill (Figure 6). The major difference is the 16-in. edger scalebreaker ahead of the descaling sprays, and the two 12-in. overhung edgers after the third and fifth 4-high mills. The edgers contribute to very close width control as well as being a necessity in producing bevel-edge skelp, square-edge or round-edge product.

The air-operated loopers and self-centering entry guides are a complete assembly that is changed as a unit when converting the mill to merchant bar operation. An air-operated cylinder raises the guide and entry table to provide clearance for roll changes.

When rolling coiled product the bar is delivered out of No. 10 finishing stand, up an inclined trough to horizontal pinch rolls, through a twist trough, followed by a switch gate, where the strip is diverted to either of two vertical pinch rolls and vibrators. The vibrators serpentine the strip onto slowly moving apron conveyors leading to the vertical coilers. The coiler equipment located at the delivery end of the apron conveyors consists of air-operated pinch rolls, vertical shears for cropping the coil, and standard ribbon reels for coiling strip, skelp and plate (Figure 7). The coils are mechanically pushed onto chain conveyors leading from each coiler to a down ender, where the coils are removed by either pole truck or "C" hook.

When rolling hot-sheared flats or plates, the inclined trough from No. 10 mill delivery is removed and a rotary flying shear is hydraulically moved into the

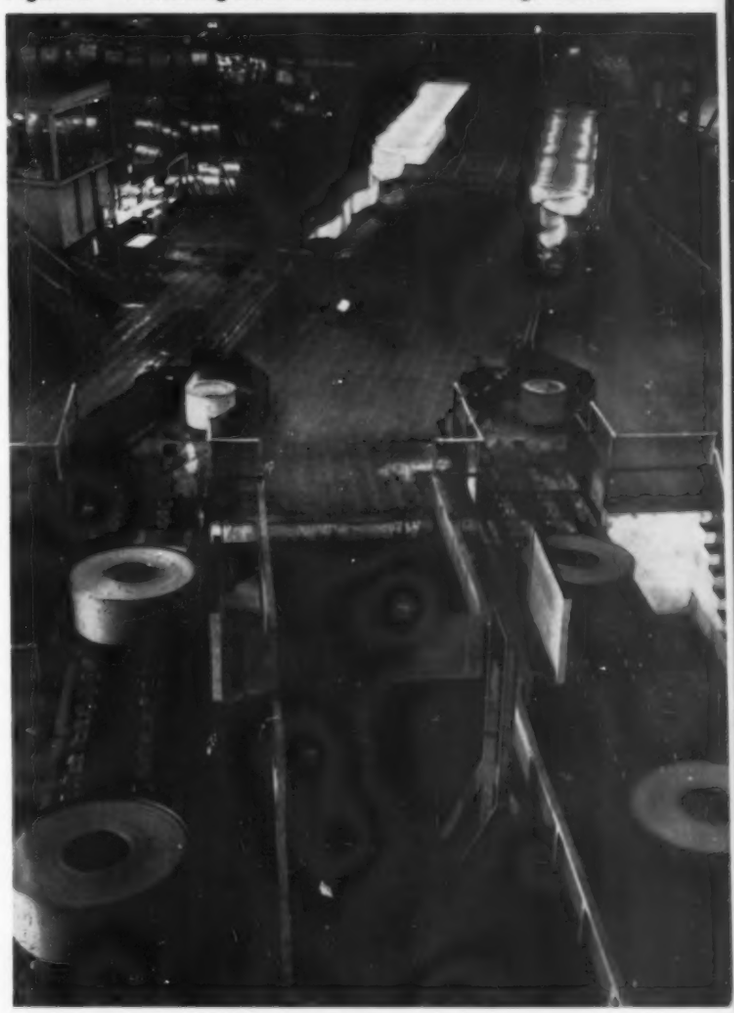

Figure 7 — Coils are mechanically placed on conveyors.

line between the finishing stand and the runout table. The sheared product may be shingled or run down the table individually to a regular strip piler, common to many hot strip mill operations.

Plates too heavy for the flying shear (0.500-in. maximum) are run through the shear without cutting, transferred across the broadside table and moved down the shear approach table for shearing to length on the Q-bar shears.

The five vertical edgers (three of which are in the

finishing train), together with an X-ray thickness gage, contribute to first-class section with respect to width and gage.

Hydraulic descaling water at 1200 psi promotes scale-free product. The water-cooled twist trough and the auxiliary equipment produce a relatively scratch-free surface suitable for the most particular hot-rolled requirements.

With finishing speeds up to 2000 fpm, temperature controls at the furnace, delay table, finisher and coilers, there is no problem in maintaining a uniform practice conducive to the best metallurgical requirements of the product. Each 4-high mill screwdown is equipped with dual selsyn-operated product meters located on the mill housing and in the speed pulpit. Thus there should never be any confusion or misunderstanding by the mill personnel relative to drafting procedure.

The product meters are of special value when rolling plates. Plate gages up to and including 0.500 in. thick are rolled in all six finishing stands. For plates heavier than $\frac{1}{2}$ in. the finishing stands are dummied in reverse order beginning with No. 10 stand. Thus, by use of the product meter, $\frac{9}{16}$ in. is finished in No. 9 stand, $\frac{5}{8}$ in. is finished in No. 8 stand and $\frac{3}{4}$ in. is finished in No. 7 stand. The mill is drafted in this manner in order to facilitate numerous gage changes on small items, without the necessity of any speed changes.

When the mill is converted from flat rolled product to merchant bar the following changes are made:

1. Edger rolls are changed if necessary.
2. Flat rolls in continuous rougher are changed to shape product rolls.
3. The six 4-high assemblies are taken out as complete units with all rolls in housings and replaced with six 2-high merchant mill rolling stands. The merchant mill rolling stands are completely set up with guides, sprays, and mill partings ready to go into operation.
4. The flat roll looping table and entry guide assemblies are removed and replaced with air-operated looping tables for merchant bar rolling.
5. Roller twisters are installed wherever used in mill train, depending on the product to be rolled.
6. Strip or round repeaters are installed leading to and between the looping stands which serve as a leader and a finisher. Of course this operation can be 95 per cent completed while the mill is operating on flat-rolled product. Likewise the rotary disc dividing shears, hot beds and bar shearing and handling equipment previously will have been made ready for operation.

Figure 8 — The two-high stands fit on the same mill shoes and on the same pass line as the four-high stands.

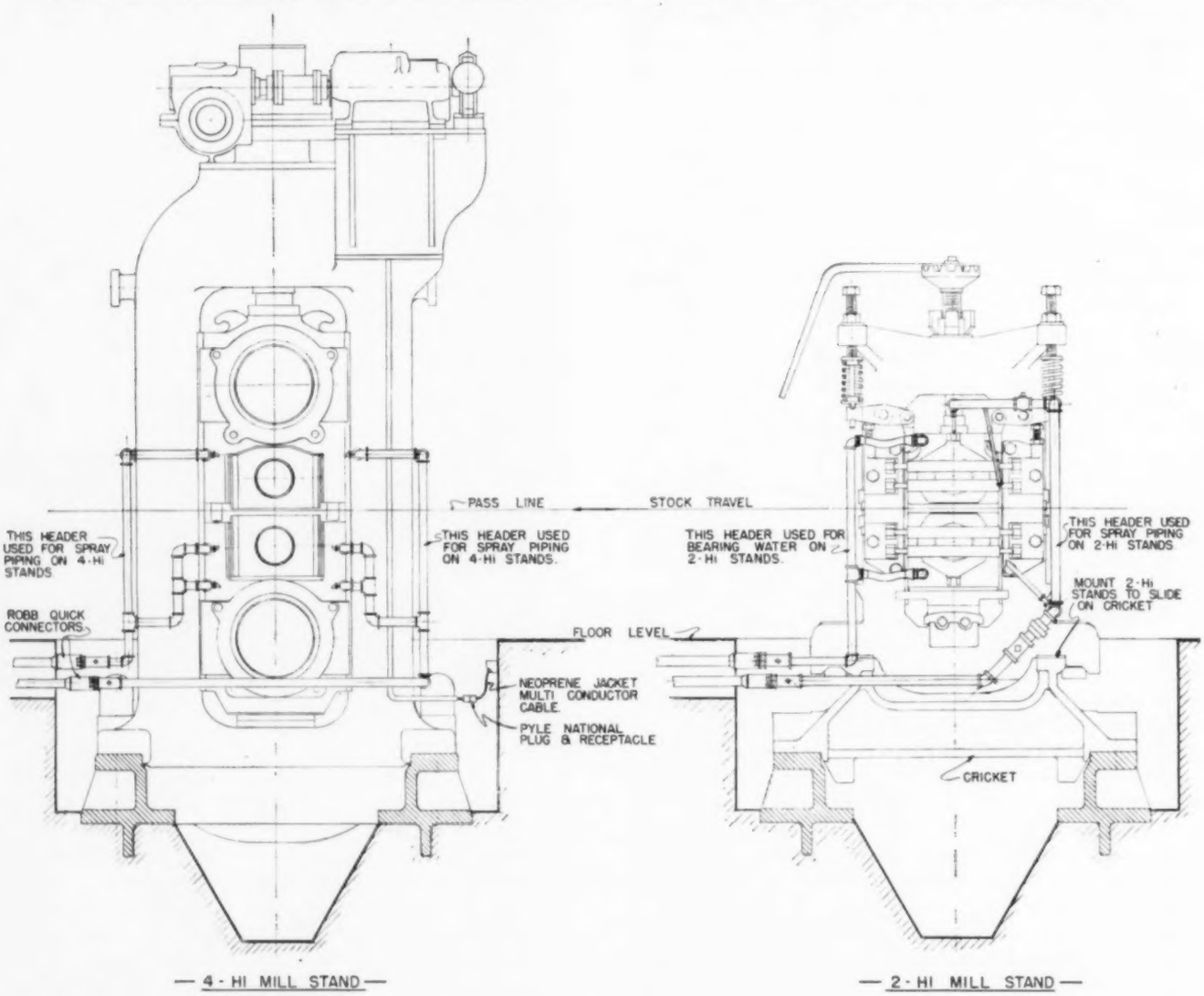
PASS LINE
STOCK TRAVEL
THIS HEADER USED FOR SPRAY PIPING ON 4-HI STANDS
THIS HEADER USED FOR SPRAY PIPING ON 4-HI STANDS.
ROBB QUICK CONNECTORS
FLOOR LEVEL
NEOPRENE JACKET MULTI CONDUCTOR CABLE
PYLE NATIONAL PLUG & RECEPTACLE
THIS HEADER USED FOR BEARING WATER ON 2-HI STANDS.
THIS HEADER USED FOR SPRAY PIPING ON 2-HI STANDS
MOUNT 2-HI STANDS TO SLIDE ON CRICKET
CRICKET
— 4-HI MILL STAND —
— 2-HI MILL STAND —

Figure 9 — Stand changes are accomplished by using two cranes.

Since the pinion housings are mounted on their beds so they can slide, there is no delay removing or putting on spindles. The spindles and pinions are simply retracted to disconnect them from the 4-high work rolls and extended when it is desirous of connecting the spindle to the 2-high work rolls.

Because the 2-high merchant bar stands in the intermediate train have phenolic resin work-roll bearings, it is necessary to have two water systems, namely, bearing water and roll-pass water. All stands for both merchant bar rolling and 4-high operations are permanently piped on the mill housings. The two roll-pass water connections to the 4-high stands are reconnected to the 2-high stands, one to the roll-pass water and one to the bearing water.

All the wiring for the 4-high screw-down motors and product meters is in armored cables fitted with plugs and receptacles. Thus in taking out the 4-highs, the electrical work is just a matter of "pulling the plug" and wrapping up the cables on hooks provided on the mill housing.

Figure 8 shows how the 2-high stands with the "cricket" adapter fit on the same mill shoes and operate on the same pass line as the 4-high stands. Note that the 2-high housing is mounted on the "cricket" so it can slide. Figure 8 also indicates how the water piping is arranged to expedite the changeover.

Figure 9 shows the actual change being accomplished by two cranes. The armored cable with plugs which serve to make electrical connections can be seen hanging on hooks on the housing.

From the foregoing and again looking at Table I, it is readily apparent that when rolling merchant bar the mill consists of thirteen 2-high horizontal stands and up to five edgers as follows:

1. A five-stand 2-high continuous rougher with two edgers.
2. A 144 ft-6 in.-delay table with crop shear.
3. An intermediate train consisting of three edgers and six horizontal 2-highs and looping tables.
4. Two 12 in. 2-high horizontal looping stands serving as a leader and finisher to complete the layout.

Also there are either round or strip repeaters to carry the bar from the last stand of the intermediate train to the leader and finisher. For heavy sections that cannot be repeated, the intermediate train delivers the product to a broadside table, where it is transferred to the leader. A skew-y table transfers the bar from the leader to the finisher. Following the finishing pass, the rolled product is delivered by a runout table to a double hot bed, equipped with carryover, shuffle bars and approach tables leading to the two Q-bar shears. Two rotary disc dividing shears are located in the runout table about 100 ft from the finishing stand. Both are equipped with "test cutters," whereby a small sample may be selectively cut from the back end of any bar. The test cutter automatically rejects the cut test to a trough alongside the runout table. Thus there is a minimum of delay in taking a test for quality. The rotary disc shears have a capacity up to 1¼ in. rounds and may shear flats and angle sections as heavy as 1½ x 1½ x ⅛ in.

As previously mentioned, the 2-high stands for the bar mill intermediate train and cross-country mills together with the pinion housings are all mounted on their beds so they can slide. A telescoping connection between the mill pinion and the drive shaft provides the necessary latitude for the movement of the roll and pinion stand assembly. The traverse of the assembly actuated hydraulically makes it possible to keep all roll passes in the same alinement and collectively in line with the repeaters which are maintained in a fixed position.

All edgers in the mill train are mounted on their beds so that they can slide and be moved laterally to whichever roll pass or line is being used. While this is a very important and desirable feature in merchant bar rolling, the slideably-mounted edgers require close attention when using the 4-high train. Because the guides for flat rolling are self-centering, mill personnel are apt to neglect the care necessary to keep the edgers in strict alinement with the flat-rolled side guides. This requires constant supervision by rollers or numerous cobbles or unusual camber will result.

Roll adjustments on all 2-high stands are made by hand-operated screwdowns through the top of the roll housings and by manually-operated horizontal screws which actuate wedges under the bottom roll bearings.

ROUND ROLLING

Rounds ½ to 11/16-in. and No. 4 and No. 5 reinforcing bars are rolled from 3 x 3 in. billets. Originally ½ to 9/16 in. and No. 4 reinforcing bar were designed to be rolled from 2½-in. billets. However, the 2½-in. billets were a hardship on the rest of the plant. Accordingly the 2½-in. billet line was modified for 3 x 3-in. billets, using the 24-in. edger as a diamond pass with approximately 19.5 per cent reduction and increasing the work in No. 0 stand to 22 per cent. This made it possible to roll a 1.375-in. square out of the five-stand continuous rougher suitable for finishing ½-in. rounds. It will be noted that while a merchant bar mill with a 145-ft delay table between the continuous rougher and finishing train is unusual, in this particular case a

TABLE I
Bar and Strip Mill Data Sheet

Continuous roughing train

Stand designation		Type of mill	Nominal diam of roll, in.	Kind of roll neck bearing	Length of work roll body, in.	Distance from preceding stand, ft-in.	Motor data—all drives 600-v—d-c: Rated horsepower	Motor speed	Gear reduction	Max. roll, rpm	Speed of stock—fpm: max	min
No. 1 Edger	Vertical scale breaker		24	Oil-flooded precision sleeve		Face of fce 67-5	250	300/900	40.417:1	22.4	140.0	47.0
No. 0 Mill stand	Horizontal	2-high	22	Oil-flooded precision sleeve	30	10-7	600	300/600	26.010:1	23.0	132.0	66.0
No. 1 Mill stand	Horizontal	2-high	22	Oil-flooded precision sleeve	30	11-9	600	300/600	21.402:1	28.1	161.0	80.5
No. 2 Mill stand	Horizontal	2-high	22	Oil-flooded precision sleeve	30	11-9	800	400/800	21.402:1	37.4	218.0	109.0
No. 2 Edger	Vertical		16	Oil-flooded precision sleeve		10-3	250	300/900	12.656:1	71.0	296.0	98.7
No. 3 Mill stand	Horizontal	2-high	22	Oil-flooded precision sleeve	30	7-6	800	400/800	16.442:1	48.8	281.0	140.5
No. 4 Mill stand	Horizontal	2-high	22	Oil-flooded precision sleeve	30	11-9	800	400/800	13.392:1	61.4	353.0	176.5

Bar rolling intermediate train or flat roll finishing train

		Bar rolling: Type of mill	Bar rolling: Type of bearings	Nominal diam of roll, in.	Flat rolling: Type of mill	Flat rolling: Type of bearings: Work	Flat rolling: Type of bearings: Back-up	Nominal diam of roll, in.: Work	Nominal diam of roll, in.: Back-up	Length of work roll body, in.	Distance from preceding stand, ft-in.	Motor data—all drives 600-v—d-c: Rated horsepower	Motor speed	Gear reduction	Max. roll, rpm	Speed of stock—fpm: max	min
No. 3 Edger	Vertical scale breaker		Oil-flooded precision sleeve	16		Oil-flooded precision sleeve					144-6	250	300/900	12.656:1	71.0	296.0	98.7
No. 5 Mill stand	Horizontal	2-high	Phenolic resin	16	4-high	Roller	Oil-flooded precision sleeve	16	28	30	10-0	1500	200/500	5.600:1	89.4	374.0	149.5
No. 6 Mill stand	Horizontal	2-high	Phenolic resin	16	4-high	Roller	Oil-flooded precision sleeve	16	28	30	13-10	1750	250/625	4.351:1	143.7	601.0	240.5
No. 7 Mill stand	Horizontal	2-high	Phenolic resin	14	4-high	Roller	Oil-flooded precision sleeve	14	28	30	12-6	1750	250/625	2.511:1	249.0	910.0	366.5
No. 4 Edger	Overhung vertical		Roller	12		Roller					7-3	150	350/1200	3.818:1	310.0	966.0	264.0
No. 8 Mill stand	Horizontal	2-high	Phenolic resin	14	4-high	Roller	Oil-flooded precision sleeve	14	28	30	11-0	1750	250/625	1.667:1	375.0	1375.0	550.0
No. 9 Mill stand	Horizontal	2-high	Phenolic resin	14	4-high	Roller	Oil-flooded precision sleeve	14	28	30	12-6	1500	200/500	Direct	500.0	1835.0	734.0
No. 5 Edger	Overhung vertical		Roller	12		Roller					7-3	150	350/1200	1.764:1	665.0	2084.0	612.0
No. 10 Mill stand	Horizontal	2-high	Phenolic resin	14	4-high	Roller	Oil-flooded precision sleeve	14	28	30	11-0	1000	250/575	Direct	575.0	2105.0	918.0

Bar rolling cross country or looping mills

		Type of mill	Nominal diam of roll, in.	Kind of roll neck bearing	Length of work roll body, in.	Distance from preceding stand, ft-in.	Motor data—all drives 600-v—d-c: Rated horsepower	Motor speed	Gear reduction	Max. roll, rpm	Speed of stock—fpm: max	min
No. 11 Mill stand	Horizontal	2-high	12	Phenolic resin	24		600	300/600	Direct	600.0	1880.0	940.0
No. 12 Mill stand	Horizontal	2-high	12	Phenolic resin	24		600	300/600	Direct	600.0	1880.0	940.0

Note—A program to widen the flat roll mill to 36 in. has already been initiated. No. 10—4-high mill is presently being operated with 36-in. long work rolls and 32-in. diameter back-ups. The repeater from No. 10 stand to No. 11 stand is on a 15-ft 0-in. radius and the one from No. 11 stand to No. 12 stand is on a 12-ft 0-in. radius.

much faster roughing mill can be utilized than would be possible if the mill were 100 per cent continuous and the top finishing speed of No. 12 stand were maintained at 1880 fpm. The faster roughing mill has proven to be valuable in obtaining higher finishing temperatures on small bar sections. The ¾-in rounds and heavier sections are all rolled from 4 x 4-in. billets.

Rounds 1¼ in., No. 9 reinforcing bar and lighter sections are all repeated. Heavier rounds are reinforcing bars are run out onto the broadside table from No. 10 stand, transferred to the table leading to No. 11 mill stand and by use of skew-y table are moved from the leader pass to the finisher (Figure 10). When rolling heavy rounds that are not repeated, an automatic turn-up to turn up the oval for the finisher is used. This automatic turn-up is air-operated, and actuated by photoelectric cell. This equipment is also fitted with a device for properly entering into the turn-up any oval delivered from the leader with a twist (Figure 11).

ANGLE ROLLING

All angles are rolled in open passes with the leg lengths maintained by the use of the edgers. Likewise all angles can be double repeated from 10 to 11 and 11 to 12 stands (Figure 12). However, it was found that 3 x 3 x ½ in. and 3½ x 2½ x ½ in. angles show some shearing by the twist plugs on the apex of the angle. Because of this, these two sizes are singly repeated from 10 to 11 and delivered to the finisher by the skew-y table. The repeater from 10 to 11 is on a 15 ft radius as compared to a 12 ft radius between the leader and finisher. The smaller radius of the second repeater undoubtedly accounts for some of the shearing troubles. However, all other 3 x 3-in. and 3½ x 2½ in. and smaller angles including those ½-in. thick can be and are double repeated. In the meantime considerable work is being done on twist plug design that is almost certain to overcome the shearing problem. It is hoped that soon all angles will be double repeated.

Billets, 3 x 3 in., are used for all even leg angles up to and including 2¼ x 2¼ in. and equivalent uneven leg angles. Larger angles may be rolled from 4 x 4 in. and 6 x 4-in. billets. At one time all 3 x 3-in. angles were made from 6 x 4-in billets. However, when rolling 3 x 3 x ⅛-in. angles from 6 x 4-in. billets, the bar developed terrifically large "dog-ears" on the head end of the bar out of the intermediate train which caused considerable trouble in the twist plugs at the repeaters. Accordingly 6 x 4-in. billets are used only for heavier

Figure 10 — A skew table moves cars from leader pass to finisher when heavier rods and bars are being made.

gage 3 x 3-in. angles, where the lesser reductions and spread does not develop excessive "dog-earing."

Of course, the dog-earing problem could be partially solved by the use of the crop shear between the rougher and intermediate train. However, since the 300-ft hot bed makes it necessary to shear both 6 x 4-in. and 3 x 3-in. billets at the furnace, nothing would be gained and the 4 x 4-in billet has proven most satisfactory.

Monthly production on the bar and strip mill has averaged over 40,000 tons for the past six months. Because of customer requirements and an Algoma 12-in. merchant mill which was in operation until August 1956, the product of this combination bar and strip mill has been predominantly flat rolled. Consequently most progress has been made in this field. However, in the past year the trend in product mix has moved slightly toward merchant bars. With the increase in bar rolling the operation has developed steadily and each rolling has been an improvement over the previous one.

Figure 11 — Equipment device properly enters bars which may be delivered from the leader with a twist.

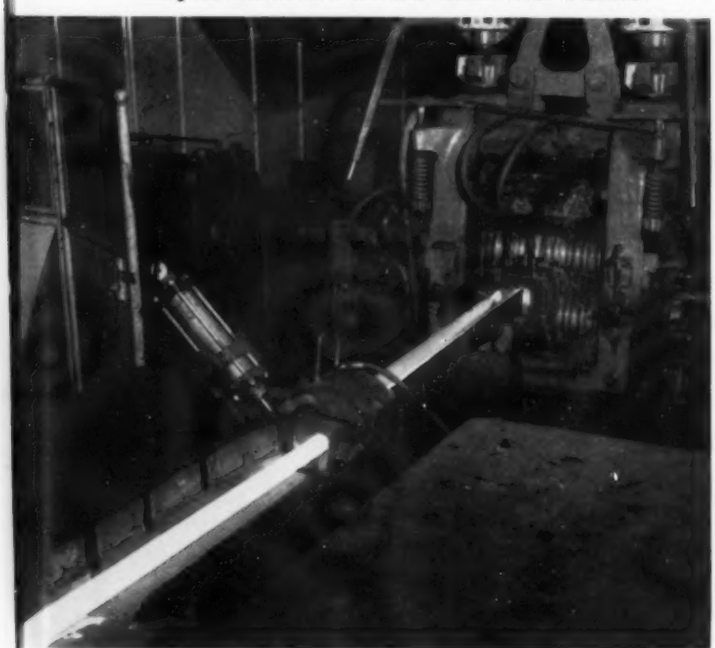

Figure 12 — The angles can be repeated from No. 10 to No. 11 and from No. 11 to No. 12 stands if desired.

On the other hand, planning for the flat-rolled operation has not come to a standstill. In December 1956, No. 10 4-high stand was widened to 36 in. as the first step to eventually rolling 30-in. wide product. This program is being carried out in steps. All new backup rolls are being ordered 36 in. long, with 32-in. diam bodies, and it is planned to successively widen out the 4-high stands and then the roughing mills with a target date for completion in late 1958 or early 1959.

The product of the bar and strip mill is processed through the finishing end which is equipped with section straighteners, roller levellers, coil cut-up lines, slitters, and batch and continuous picklers.

Complementing the operations of the bar and strip mill is a modern cold roll department consisting of a 4-high reversing mill, 2-high temper mill, adequate single-stack annealing equipment and the usual coil slitting and shearing lines.

DISCUSSION

PRESENTED BY

HERMAN E. MULLER, Superintendent Roll Dept., Inland Steel Co., Indiana Harbor Works, East Chicago, Ind.

ERNEST E. DAVIS, Superintendent of the Hot Mills, Carpenter Steel Co., Reading, Pa.

W. H. MULFLUR, Division Superintendent, Algoma Steel Corp., Ltd., Sault Ste. Marie, Ontario, Canada

Herman E. Muller: The mill described is, to say the least, unusual. We are impressed by the performance of the mill. While it is true that mill time spent on bar production has been slight, we understand that the bar performance has been very good.

The motoring, with respect to bar rolling, due to the versatility feature is more than ample. The fact that the mill can later be converted from versatile to a straight bar mill and wider strip mill indicates good planning and foresight.

I would like the author to comment on their experience with the open pass method of rolling angles. I would like to ask if back-up roll spalling has been a

problem because it has been more prevalent in narrow strip mills.

Ernest E. Davis: There seems to be two general plans of combinations of mills. One plan such as our mill at Carpenter uses stands in various ways to roll the products and the other way uses dual purpose equipment. I think this Algoma mill is a very fine example of the latter type of combination.

The method of substituting 2 high stands for 4-high and maintaining the same pitch line is a tribute to the ingenuity of the designers. I would like to ask Mr. Mulflur if he can tell us how the descaling is actuated on the mill, and is the twist trough a roller trough or a solid one? I noticed that the strip goes up an incline at the finishing end. I wonder whether there is any problem of buckling, because of that incline.

What is the largest section repeated when rolling rounds, from the intermediate train to the leader pass?

W. H. Mulflur: In answer to Mr. Muller's question on our experience with open-pass method of rolling angles, we might say we are extremely satisfied with this method. We have no trouble getting section, and the angles produced are first class in every respect. The open-pass method lends itself well to small item rolling and the general flexibility of the mill.

Regarding backup spallage, we follow the general pattern that roll spalling is more prevalent in narrow strip mills. We have reduced spallage considerably by changing more backups and increasing the stock removal during the dressing operation.

Mr. Davis has raised the question of the largest round section repeated from the intermediate train to the leader pass. We regularly double repeat $1^{1}/_{4}$-in. rounds. Our pass design for this section calls for a square approximately 1.36 in. on the side. Regarding the actuation of the descaling sprays, we have accomplished this three ways, manually, flag switch, and electric eye. At one time we hooked up the descaler at No. 1 edger to operate off a load relay. However since it was desirable to have one spray header run all the time to prevent the pumps from churning and thus heating up, this practice was discontinued and No. 1 spray header is on continuously.

The twist trough is of cast iron and water cooled. The inner surfaces of the trough are drilled with $^{3}/_{32}$-in. holes through to the water jacket. There are approximately five holes per square foot. Thus the cooling water also lubricates the working surfaces of the trough and contributes to the elimination of scratches. The original twist trough was not as well water lubricated and cooled. Consequently hot spots occurred which resulted in scale pickup on the surfaces of the trough, which in turn caused drags and scratches on the surface of the product.

The problem of buckling of the strip on the inclined trough is practically nil. Providing the strip has good shape and is straight, there is no difficulty pushing a 22-in. x 0.047-in. strip from the finishing mill to the first horizontal pinch rolls.

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Trends in Electrification and Automation of Iron and Steel Processes

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. . . . new mills and new processing lines are producing more steel more automatically and to closer tolerances . . . . advances are due to higher power, better control and automatic computer systems . . . .

▲ AS the country has developed and as technology has advanced, sizes of electric furnaces and rolling mills have increased significantly; material handling has been speeded up and made more automatic; processes have been combined; new processes have been developed; and, most process speeds have been increased. These process changes have resulted in larger electrical load blocks, larger electrical load swings, less diversity in electrical load because of the reduction in the number of independent blocks of load and a persistent increase in industry average of kilowatt-hours per ton of finished product.

Today, each process equipment has enormous production capabilities, and a greater capital expenditure is required for each new facility. As a result there is not only a desire, but a necessity for better control of production and quality. Economic pressures exist to accelerate the evolution from mechanization to automation. Long range planning becomes ever more important. Processes need to be reviewed in terms of our expanding technology to be sure that today's expansion and modernization programs represent desirable and wise contributions to tomorrow's operation.

PROCESS AND ELECTRIC SYSTEM RELATIONSHIP

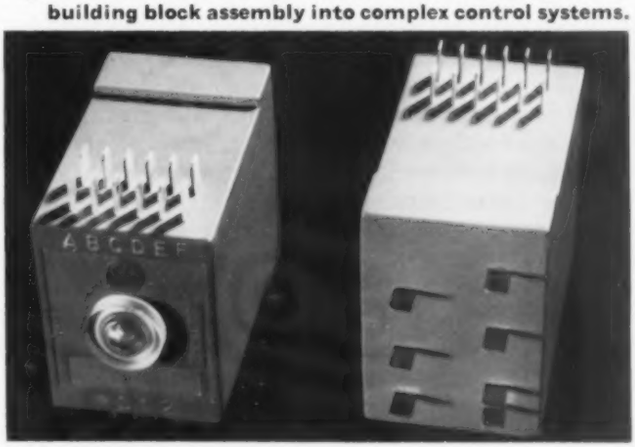
Recent articles in the technical magazines emphasize the modification and redesign of processes around modern electric systems and technology. As production requirements continue to increase, there is growing recognition that improvements in production and quality can be achieved at lowest increase in investment through the use of modern automatic electric drive systems. Automation is, however, more than just working around the fringes of a process. First, horsepower requirements on main and auxiliary drives increase directly with the increase in work done per unit of time or the increase in tons per hour. Higher production, higher process speeds and larger machinery require greater precision in automatic control as well as so-called automation features.

There are numerous published articles dealing with automation on a general industry basis. Treatment here will be limited to the changing electric system technology and the influence of this technology upon the automation of some of the iron and steel processes. As such, manufacturing operations—making, inspecting, assembling, testing and packaging will be covered.

Volume and nature of the product are generally considered to be two important qualifications for the economical application of automation in any industry. Volume certainly exists insofar as many steel products are concerned. The tough problem seems to be the nature of the product. Nature of the product is considered to include elements of product design, product standardization and materials and processes.

The nature of steel as a product is so fundamentally different from the nature of a chair or an engine as a

Figure 1 — New switching device is static and designed for building block assembly into complex control systems.



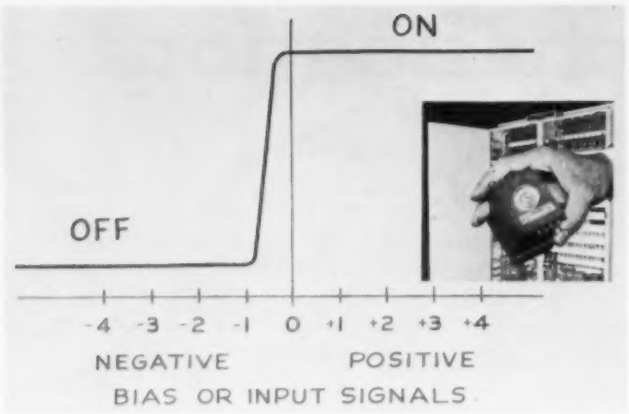


Figure 2 — Units of bias and signal are combined to give bi-stable "ON" or "OFF" operation which is indicated by monitor light.

product as to cause the last two elements, materials and processes to overshadow other elements in importance. The process equipment is an extremely important consideration since the immense machinery necessary for metal rolling and processing is not inexpensive. Drive load characteristic is also worthy of special consideration. Not only does this load characteristic affect the complexity and cost of the electric drive system, but the ability of the electric drive system to do the job properly can significantly affect the physical characteristics of the product itself. For example, when rolling strip, the dimensions of the material are not only affected at the instant the metal is in the roll bite, but during the time the metal is traveling between stands as well. Such is not the case between operations on an engine block.

In steel, as in most other industries, the road to complete automation is an evolutionary one. Steel is a basic product used in many forms finished and semifinished. Because of the tremendous investment in equipment and the space involved, it is impractical for every steel plant to have a continuous flow from ore to any one of the finished products such as rod or sheet. Therefore, the industry is bending all its efforts towards automation in the individual steel-making, rolling, and processing operations or combinations of operations where feasible. This takes the form of better material handling and more automatic control.

Automation should be attempted only after complete analysis of a process and only with a clear understanding of the fundamentals of the process. As steel plant operations and processes are analyzed critically, it has become increasingly apparent that not enough is known about the fundamental behavior of some of the processes. Much data is available and tremendous amounts of data are recorded and logged daily. However, this data is not in a form permitting rapid analysis and there is a growing feeling that it may not be complete enough.

Many times operating practice and even the process itself should be modified. Certainly, possible alternate system arrangements and designs must be considered and evaluated. A real effort should be made to seek out and adopt the optimum system for the process.

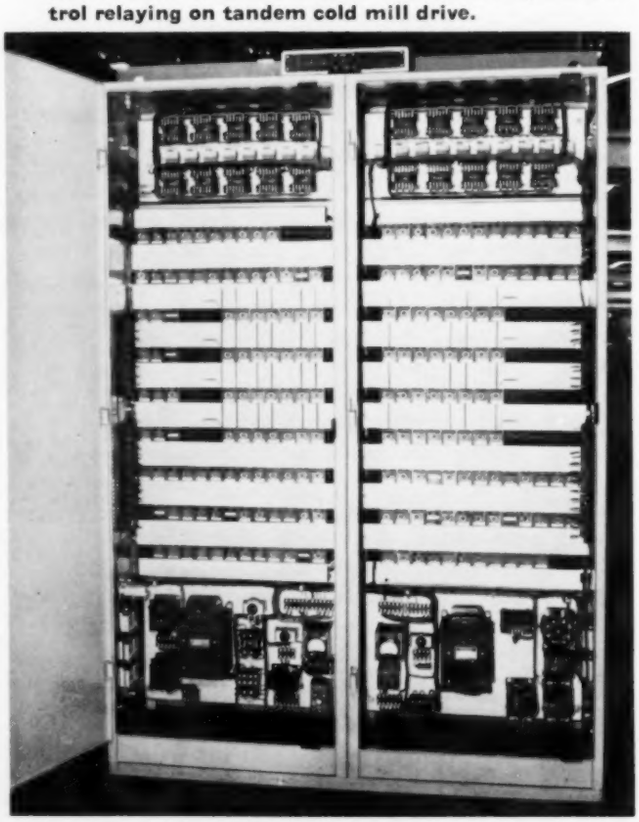
Today, system design requires a thorough knowledge of actual processes, principals of feedback control, available system components, new techniques and imagination. It requires familiarity with and use of analog and digital computers. There are many possible system designs and arrangements. There are innumerable possible adjustments of multiple feedback circuits. Design variations can either be shaken out on the job or by means of engineering analyses on computers. Today's large expensive rolling mill systems are too complex to determine optimum design by pure mathematical analysis, and during startup it is not possible to know when the system has been adjusted for best performance without having previously made a computer study and having the results available. In an automated process, production level and product quality are closely keyed to and dependent upon electric drive system performance. Also, continuing competent technical maintenance will be as important to continuing performance as is proper design and installation.

AUTOMATING A PROCESS

An operations research and synthesis approach is necessary. There should be basic long term planning towards definite goals associated with the automation of such expensive process equipments as are found in the steel industry. Such efforts should be devoted towards a visualization of the basic automated process system of the future. A basic automated process would include: regulating systems, automatic inspection, automatic data logging, automatic data processing, programming, computing and reprogramming.

Regulating systems are widely used today to continuously monitor process performance. Numerical card programming is the new vehicle available to accurately specify the required performance to the control systems.

Figure 3 — Static control units, magnetic power amplifiers and static regulating elements in this equipment replace motor operated rheostat and preset speed control relaying on tandem cold mill drive.



Automatic numerical data logging and data processing systems are also being incorporated into steel plant operations. Today the industry is considering relatively simple data logging systems and independent programming systems. After experience is gained, these systems will be extended to increase the amount of data logged and to include more sophisticated methods of data processing. This phase in turn will be followed by the incorporation of computers for calculating performance, operating parameters, figures of merit and even selling prices of some finished products. In the final phase, the computed information will be used to reprogram and control the processes automatically and to program subsequent processes.

Today, we are in an era of electronic techniques. Such techniques do not restrict us to the use of vacuum tubes but encompass the now familiar magnetic amplifier, the newer transistor, static switching and other newer developments reported in the technical and popular press, but not yet developed to the stage where either the electrical industry or the steel industry would want to see them used on critical or high production processes. New systems should utilize fully proved techniques and components. Efforts should continue to be exerted to design for the needs of the industry and the process. Designs should not be overly complex, should recognize the necessity for quick and easy servicing and should be as reliable or more reliable than control systems presently used.

Practically all large industrial operations now use business machines and computers in their financial operations. Programming and data processing systems should be able to use the same data vehicle as these existing business machines. This can be done by utilizing the readily available forms of punched cards, punched tapes and magnetic tapes.

STATIC SWITCHING

In this day of changing technology even the relay is being displaced on some applications. New static switching systems utilize static magnetic and solid state devices to accomplish control functions that are normally performed by contact making devices. Static switching systems consist of varied combinations of only seven basic control units. This simplified building block approach utilizing built-in stab-on bus and quick-connect terminals is a fundamentally new approach to industry type control systems.

These units can be combined with static power supplies, static amplifiers, and static regulators to provide completely static control systems. The static switching units are the decision making parts of the equipment. They accept electrical signals from sensing elements which measure speed, load, position, pressure, etc. Using built-in intelligence to interpret these signals, the static switching units control a power amplifier, which in turn performs the required function.

Most of the basic units have a built-in monitor light, which shows the condition of the operation of the unit. The units are bi-stable, that is either "on" or "off." The monitor light will be on when the unit is on, and off when the unit is off. Units of excitation are applied to input terminals to activate the units. They are multipurpose units specifically designed for complex systems type drives. In this new static switching system, the phasing problem has been eliminated by converting incoming a-c power to d-c within the individual units. This obviates the necessity for carefully arranging correct phase relationships between a unit and its input signal, thereby providing for simplified circuitry and mechanical layout. Because of this, oscilloscopes are not required for phase checking or trouble shooting. All that is required beyond the monitor lights furnished is a standard volt-ohm-meter.

The first of these static switching equipments was placed in operation at our appliance center in Louisville, Kentucky, where the system controls the switching operations of a new automatic conveyor system that routes a variety of major household appliances from the main product transfer conveyor to one of several warehouse shipping areas.

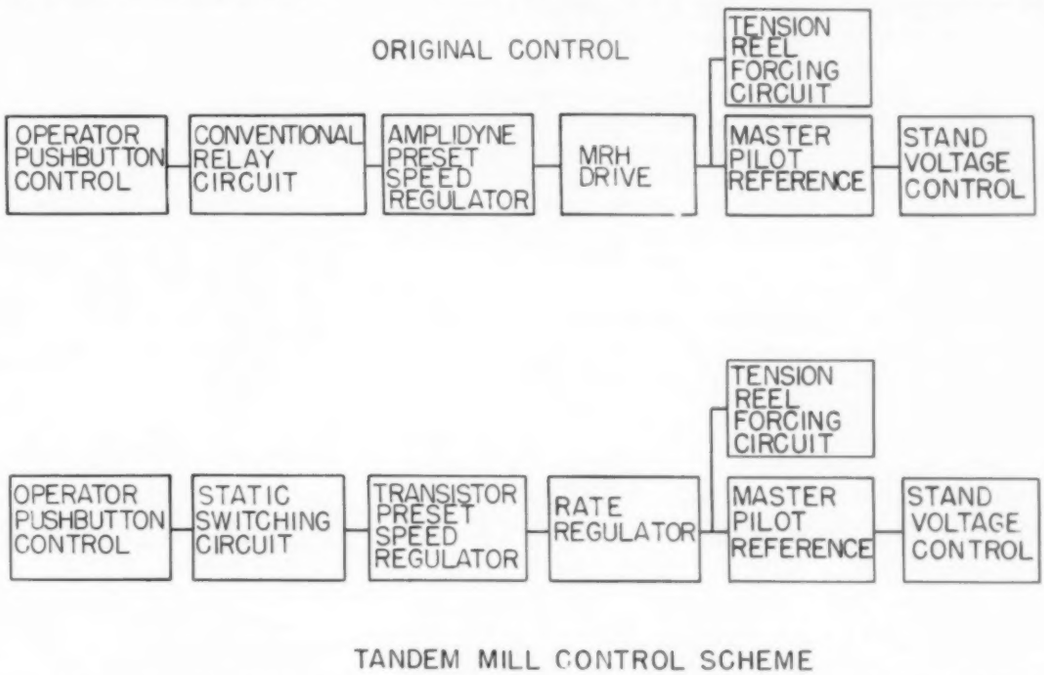


Figure 4 — Block diagram of original and new static control system for portion of tandem cold mill master control.

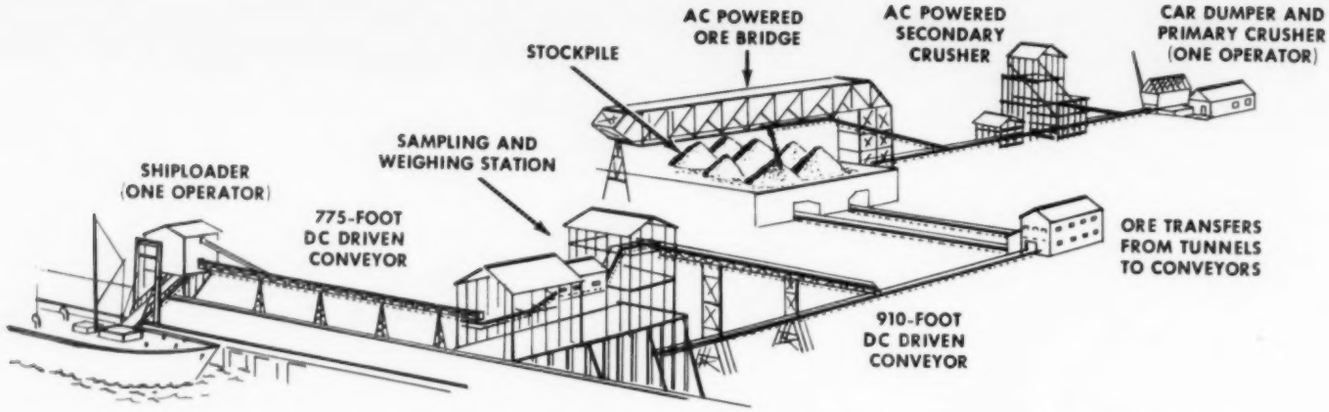


Figure 5 — Highly automated ore handling system handles 6000 long tons per hour with three operators.

A second static switching system was installed at the Youngstown Sheet & Tube Co., Indiana Harbor, Indiana on a four-stand tandem cold strip mill. This is believed to be the first such application of static switching in the steel industry. Here, modern concepts of static regulating equipment involving transistors were combined with the static switching to replace the master motor-operated rheostat and the preset speed control on this tandem mill. Lower maintenance and circuit simplification have been achieved without change in operation.

The block diagram, Figure 4, shows the conventional system and the new system. The main motor operated rheostat and associated preset speed control were replaced by a static rate regulator consisting of magnetic and transistor amplifiers. This regulator serves as reference to the master pilot regulator which determines mill voltage. It also serves as reference to the winding reel forcing circuit whose function it is to apply the correct quantity and polarity of inertia compensation to the reel.

The mill can now be accelerated and decelerated without operation of the master control relays. The "monitor" lights at the static switching panel give an easy indication of whether the operator has called for thread, low run or run speed. The changeover eliminated the rotating regulator and adjustable voltage control which formerly regulated the speed of the MRH drive. It was not considered advantageous to convert jog, circuit breaker and protective relays because their operation is infrequent.

Engineering is now in progress for a slabbing mill with close-coupled edger drive and the associated auxiliary drives. This mill, which will go into operation in late 1957, will be designed with controls utilizing static switching. For the main drive, edger and d-c auxiliaries, all devices which operate with each mill acceleration, deceleration or reversal will be static. This includes both the voltage as well as the field control functions. As a result, there will be no conventional relays operating during normal mill operation. It is anticipated that millions of relay operations will thus be eliminated with a corresponding savings of maintenance and inspection time. Static units will be used to replace interlocks in the regulating circuits including load and voltage balance, stabilizing and suicide circuits.

At this time there remain several functions which will be accomplished by conventional relays and whose conversion to static switching is not considered advantageous. This includes most protective circuits, such as overcurrent, overvoltage and field loss. Jogging and circuit breaker control will also be accomplished with conventional relays. These exceptions are justified by infrequent usage.

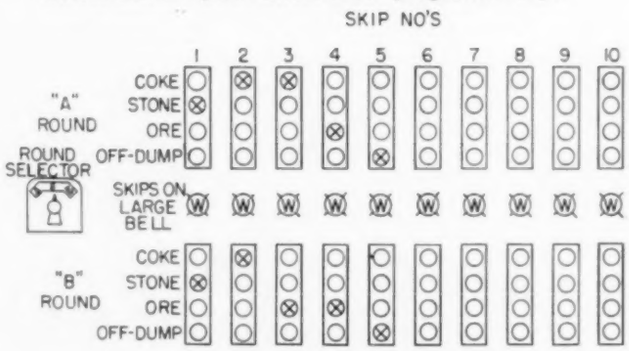
The new static switching system is not considered a "panacea" for all control problems. It is expected that static switching will be useful where frequent or continuous operations are needed or where complex systems or adverse atmospheric conditions exist.

In applications where a million operations are accumulated in a few months, conventional devices quickly exceed their maintenance free life. Static switching units are natural for these applications. Advances in automation increase the complexity of control systems and are generally limited by the problems inherent in maintaining the great number of existing devices and trouble shooting the complex circuits. The reliability and simplified circuitry of static switching systems make them especially applicable in these areas.

RAW MATERIALS HANDLING

During 1956 the American iron and steel industry is estimated to have consumed a diet of some 273,000,000 tons of raw materials. This staggering tonnage of ore, coal and limestone, if placed in ore cars and hoppers and coupled together would make up a train 29,000 miles long—a distance equal to circling the earth one and one-tenth times. This hypothetical train would be carrying 135,000,000 tons of ore, 100,000,000 tons of coal and 38,000,000 tons of limestone.

Figure 6 — Program charging system for blast furnace skip hoists utilizes push buttons for program setup.



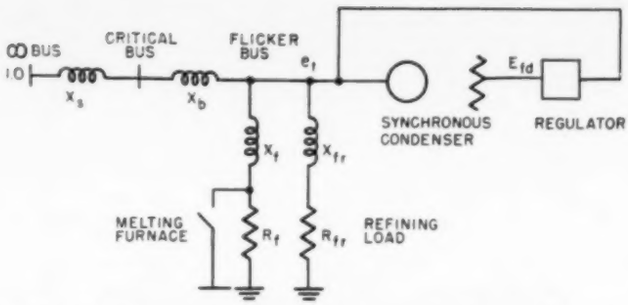


Figure 7 — Recent computer studies and operating experience on arc furnace systems of this type have established new criteria for system design.

These vast tonnages were mined, processed and sized, transported to the mill sites, stockpiled and then rehandled around the clock to the points of use in the mills. To this must also be added the approximately 44,000,000 tons of steel scrap required to produce 1956's 115,000,000 net ingot tons.

During the last several years the iron and steel technical publications have presented several articles on the subject of material handling. One article stated that the cost of handling materials represented 20 to 25 per cent of the total production labor cost. This is a tremendous expense and justifies serious consideration of every possible means to obtain improved performance.

Another article on the general subject of increasing production claims that a manufacturing efficiency of 4 per cent is considered good. This means that the material will actually be worked on only 4 per cent of the total time it spends in the plant. What tremendous waste! A waste of capital tied up in inventory! A waste of plant space being used for storage instead of processing. One of the best ways to reduce that waste is to obtain a smooth and automatic flow of material from one process to the next.

With tremendous magnitudes of materials to be handled, with such a low existing process efficiency and with such a high component of cost presently involved, it is to be expected that more automated materials handling methods will be evolved. Electric load growth is to be expected because electric systems will replace trucks, locomotives and similar shuttle type methods.

An excellent example of up to date raw materials handling is at U. S. Steel's Orinoco, Venezuela ore shipping installation. Here one operator starts the crushers and conveyors leading out onto the stocking bridge. He then runs the car dumper and the barney haul at the rate of one car every 53 seconds. Another operator on the stocking bridge controls the movement of the bridge to the desired dumping location on the stockpile. Ore is reclaimed by being scraped off shelves onto two conveyors and tunnels under the stockpile. From the tunnel, ore flows along a conveyor system to a boat loading tower running the length of the pier, and then across shuttle belts into the boat. The one operator on the loading tower controls the speed of the system from the tunnels to the boats with adjustable voltage drives tied together by rotating regulator control. The speed of the entire loading out system can be controlled as a single unit. Some 6000 long tons per hour can flow over the system. Of course, there are weighing, sampling and maintenance personnel, but the basic system of dumping, crushing, stockpiling, reclaiming and boat loading is done entirely electrically and controlled by just three men. Numerical data logging and processing might be added to improve the effectiveness of the over-all operation and to make the system in its entirety even more automated.

IRONMAKING

Ironmaking principles as exemplified by the blast furnace and their charging methods remain much as they have since the early days of commercial ironmaking. The motorized skip hoist has replaced the wheelbarrow as furnace capacities have grown. Program charging control is presently in use on a number of the more modern high capacity furnaces. On these installations the setup of the sequence is made by pressing buttons on the charging control operator's panel. These buttons set up the order in which the ore, coke, and limestone can be fed into the skip bucket.

Programming could also be accomplished through the use of prepunched accounting cards. Since blast furnace charging programs change only infrequently, it is currently believed that the push button system is adequate. An automatic data logging system could be used with either type of programming system to obtain a permanent record of blast furnace operations. Such records would facilitate easier correlation of blast furnace performance with blast furnace practice.

STEELMAKING

In the steelmaking process, the high first cost of the open hearth shop has been contributing to changes in methods and to greater electrification of this process. First cost of the electric melt shop and the oxygen converter shop are reported at half that of the open hearth shop of equal annual tonnage. Electric furnace production for 1956 was about 8,000,000 tons or 7 per cent. Authorities predict that it will double during the next 15 years. Today, the largest electric furnace in operation is 200 tons, but 250-ton units are being considered.

The arc furnace load is characterized by rapid fluctuations in kilowatts and kilovars during the early phases of the meltdown period. The rapid kilovar changes are of particular concern because they tend to cause voltage changes in the supply system and may create a flicker voltage problem if the supply circuits are not stiff enough. The use of a synchronous condenser and buffer reactor to partially shield the utility system from the rapidly changing kilovar load is very effective if properly sized and proportioned. Since the buffer reactor is considerably less expensive than the synchronous condenser, it is desirable to use as large a buffer reactor and as small a synchronous condenser as will meet the requirements.

One of 1957's AIEE technical papers reports on an analytical study to determine the optimum buffer reactance and synchronous condenser size. In the paper it is concluded that the condenser size should ordinarily be selected on the basis of steady-state requirements. Second, when the dynamics of the system are considered, the optimum value of buffer reactance is determined more by voltage flicker than by stability. Third, the presence of additional refining load decreases the optimum value of buffer reactance. Fourth, maximum

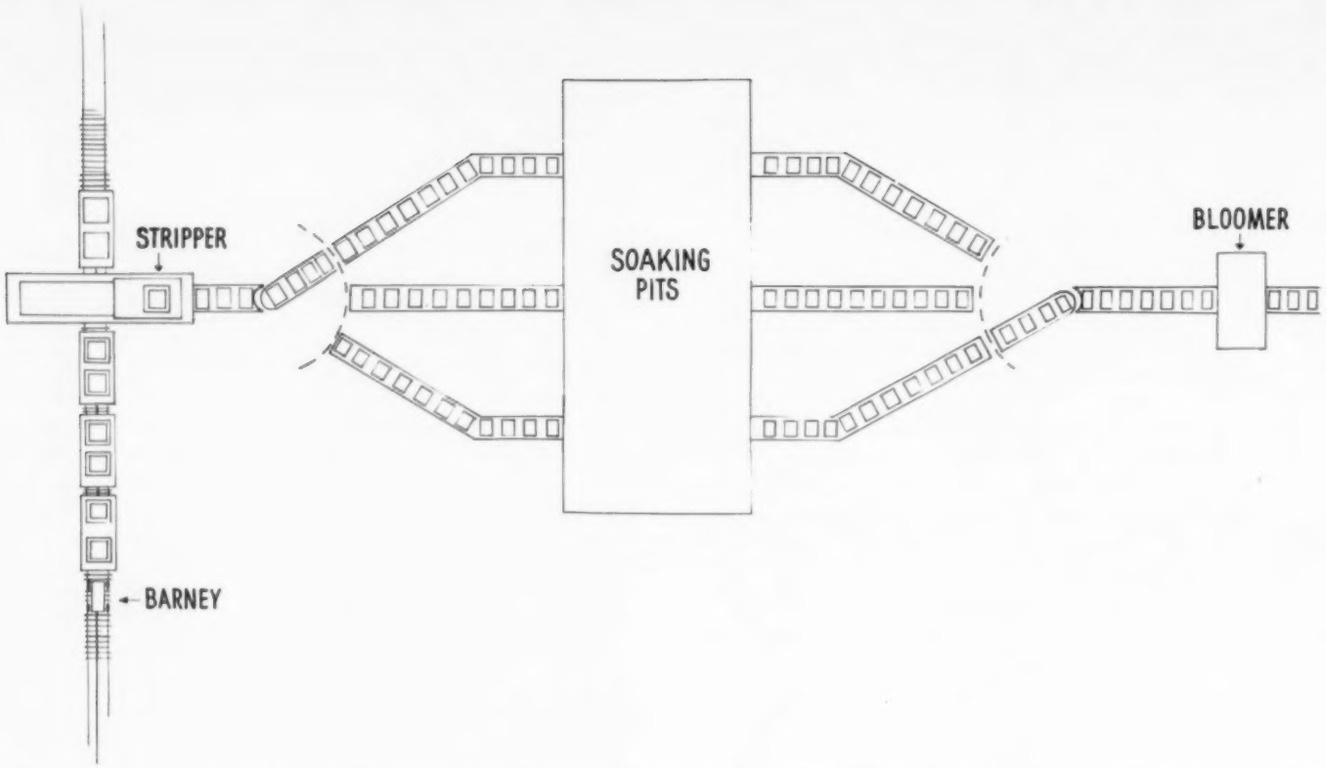


Figure 8 — An operations research and synthesis approach to automation of soaking pits involves consideration of other than traditional practices. Here is one possible system.

shock loading at, or very near to, the natural frequency of the system can force the condenser out of step over most of the practical range of system parameters. Operating experience with a system selected on the basis of these criteria is described in a companion paper.

Extensive analytical studies of the electrode drive system on electric arc furnaces have resulted in a recent doubling of the upper limit of electrode speeds. During recent years, electrode speeds have been between 24 and 60 ipm with an average for all furnaces around 40 ipm. The computer study based upon mechanical data on a 100-ton furnace with a 25,000-kva furnace transformer indicated that it would be entirely possible to use electrode speeds up to at least 120 ipm and possibly higher.

A number of furnaces are now in operation with electrode speeds up to 120 ipm. The furnaces operating with these high electrode speeds have shown an improvement over older furnaces with the same rating. At Atlantic Steel, for example, the new furnace takes about 85 per cent of the time per heat of the old furnace of same size and rating. No one gives all the credit to higher electrode speed, because other improvements including shorter secondary cables between the furnace transformer and the furnace were also made. However, the higher electrode speed was undoubtedly a very important factor in reducing the heat time. In addition, the well-designed and well-adjusted electrode regulators tend to make the possibility of repeated shock loadings on the synchronous condenser-buffer reactor system so unlikely that it should not be considered to be the limiting criterion.

SOAKING PITS

Process and material handling methods are well established between the open hearth and the blooming mill. However, today we should not continue to remain satisfied with traditional methods. We should do some "imagineering" and consider other possibilities. First, let us review today's practice. There is a stripper, frequently two soaking pit cranes, soaking pit cover cranes, and an ingot buggy to deliver ingots to the bloomer. Every time a soaking pit cover is removed, one can see dollar bills floating up with the escaping heat. And, then more dollar bills are spent in adding air conditioners to the soaking pit cranes so that the operators do not have to be relieved every half hour.

Our steel mill materials handling application engineer proposes a different scheme. Suppose that a fixed position stripper is installed; this would mean not only a lower price for the stripper, but also a less expensive building by eliminating the crane travel and reducing building stresses. The stripper operator would have a barney-haul or a car-pulling winch available to position each mold under the stripper after a string of mold cars had been brought to the starting position. The ingot would be placed on a conveyor roll table that would carry it to the selected soaking pit for each type of ingot. Instead of removing a top cover and letting heat rise out of the pit a slide door would be raised, much like the door of an open hearth. When the blooming and slabbing mill operator starts the last pass through his mill, he will push the proper button to bring from the soaking pit the ingot required by the production schedule.

This arrangement not only eliminates the soaking pit cranes, the soaking pit cover cranes, the ingot buggy, and their operators, but it also reduces the possibility of damage to the soaking pit walls and floors and should reduce the time required to get ingots in and out of the pit. Numerical data logging and processing equipment

could be used to automatically record pertinent operating data on punched tape, punched cards or magnetic tape and give automatic and simultaneous typewritten report of out of specified operation to the production office, to the pit operator, to the mill roller and even to the superintendent. The blooming mill could even be scheduled and programmed from this data. Is it possible? Certainly! Is it practical? Time will tell.

REVERSING HOT MILLS

All of the rolled products of the steel plant pass through the reversing blooming and slabbing mill. As finishing facilities have been increased or speeded up, there has been an ever increasing demand to raise the output of the reversing mill. The output of this mill, as of any mill, is very much related to its utilization factor. If there is no metal in the mill, there is no output. This is an important consideration because on most reversing mills, the slab will be in the mill generally from 25 to 50 per cent of the time. The remaining time is spent in manipulating, starting and stopping, and operating the screwdowns. For this reason, attention must be paid to the complete system of main and auxiliary drives if best possible productivity is to be obtained.

An analysis of mill operation can be made to determine the bottleneck. It is important to remember that tonnage through the mill requires work of the various parts of the drive system. Part of or all drives might have to be increased in horsepower size as well as the control changed to permit and achieve a significant increase in tonnage.

Blooming and slabbing mill equipments recently purchased are being charged by management to produce tonnages beyond present day experience. For example, one steel plant expects their new reversing blooming and slabbing mill to ultimately produce 5,000,000 ingot tons per year. This mill system consists of a 12,000-hp, d-c twin drive motor for the horizontal rolls and a 4000-hp, d-c motor for the vertical edger rolls together with a flywheel motor-generator set and the control and excitation equipment. Auxiliaries and cranes include approximately 125 drives totalling 9000 hp.

Figure 9 — Roll opening and mill speed are set automatically when operator pushes "Next Pass" push button on this punched card programmed reversing roughing mill.

Figure 10 — Rolling schedule change is made by changing program cards in card reader.

A digital computer analysis of possible rolling schedules indicates that the steel company's expected ultimate production can be achieved within the thermal capacity of the drive system equipment. It will, however, require utilization and co-ordination beyond previous experience. This high level of production cannot be obtained by means of greater reduction per pass but must be achieved by having the metal in the rolls a greater percentage of the time. Needless to say, the new mill will have the most modern control system complete with punched card programming.

Punched card preset screwdown control was placed in operation October 4, 1956 on the reversing roughing mill at the Brackenridge plant of the Allegheny-Ludlum Steel Corp. From all indications, this is the first operating installation of a punched card preset control in the steel industry. The mill operating personnel are extremely pleased with the equipment, and feel that its accuracy and flexibility will open new horizons in the quality control of their product.

This control frees the operator from the tedious job of manually setting the screws to the proper opening for each pass. Instead, the operator now selects the proper card from his file, inserts it into the card reader, and then initiates operation of the screwdown by means of a simple push button. The use of punched cards allows the operator to maintain a large number of schedules on file for a wide variety of products. At the same time, the punched card permits a rapid change from one schedule to the next. Previous preset screwdown controls were somewhat handicapped due to the time required to change from schedule to schedule.

The brains of this control utilize an electronic counter which is preset by the punched card to the desired screw-

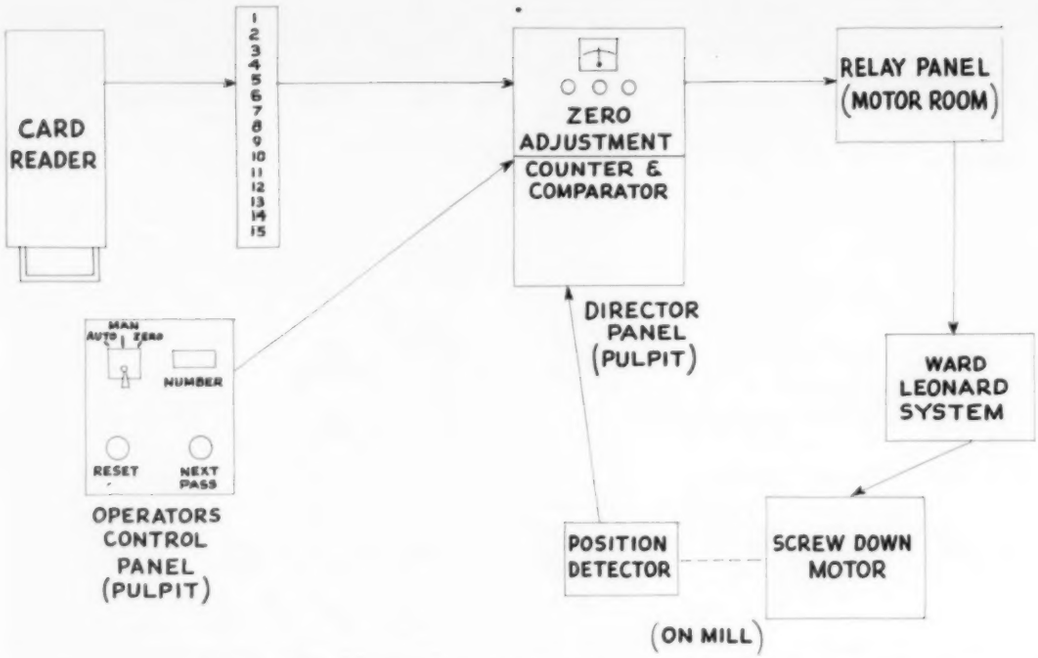


Figure 11 — Block diagram shows basic elements of card program system for a rolling mill.

down position. The actual position, or feedback, is measured by pulses from a magnetic pickup-toothed disk transducer and is compared with a value preset in the counter. The error in position is converted to a proportional signal and is used to drive the adjustable speed screwdown control. The equipment utilizes vacuum tubes, transistors and magnetic amplifiers. The card reader is a static reader and accepts standard IBM paper cards.

This particular equipment is arranged for a maximum of fifteen programmed passes. The maximum opening is 9.99 in. with settings provided every 0.01 in. The accuracy of the equipment is approximately 0.005 in. The maximum screwdown speed of this installation is 40 in. per min.

Other card program screwdown controls for reversing mills are presently under construction for Bethlehem Steel Co., Jones & Laughlin Steel Corp., United States Steel Corp. and Inland Steel Co. These new equipments use a selsyn system for positioning rather than an electronic counter. Some of these new controls will be incorporated in completely automatic mill programming systems in which all mill functions will be automatically controlled. Such systems will allow the operator to act merely as a supervisor after initiating the process.

Various modes of operation are possible. Programming could be incorporated with automatic numerical data recording and processing equipment as previously mentioned. Production and accounting information could be included on the programming card or on an auxiliary card for later processing of all data in standard business machines.

HOT STRIP FINISHING MILLS

On hot strip finishing mills the trend has been towards more connected horsepower to permit finishing more products at higher speeds, and with considerable effort being expended to obtain better control of quality of the product. As the connected capacity has increased, the potential d-c short circuit currents and resulting forces have made it difficult to design satisfactory d-c bus systems. As a result, the trend has been to split the bus into sections. This gives advantages of reduced short circuit stresses and damage, increased flexibility in speed cone and rolling schedules, but with the disadvantage of loss in diversity of rolling loads. Finishing stands are powered individually on three hot strip finishing mills

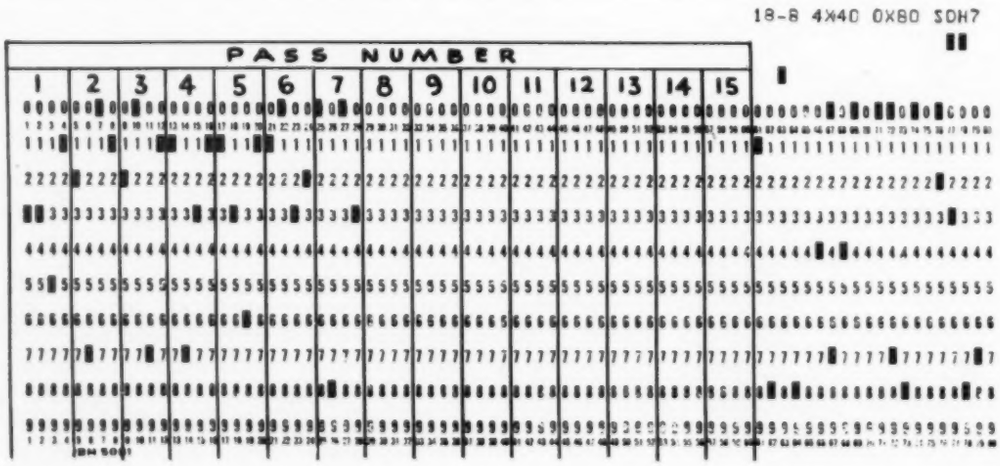


Figure 12 — Decimal code shown on standard business machine card permits instant check by operator. First three columns for each pass indicate roll opening. Fourth column is code for main drive speed.

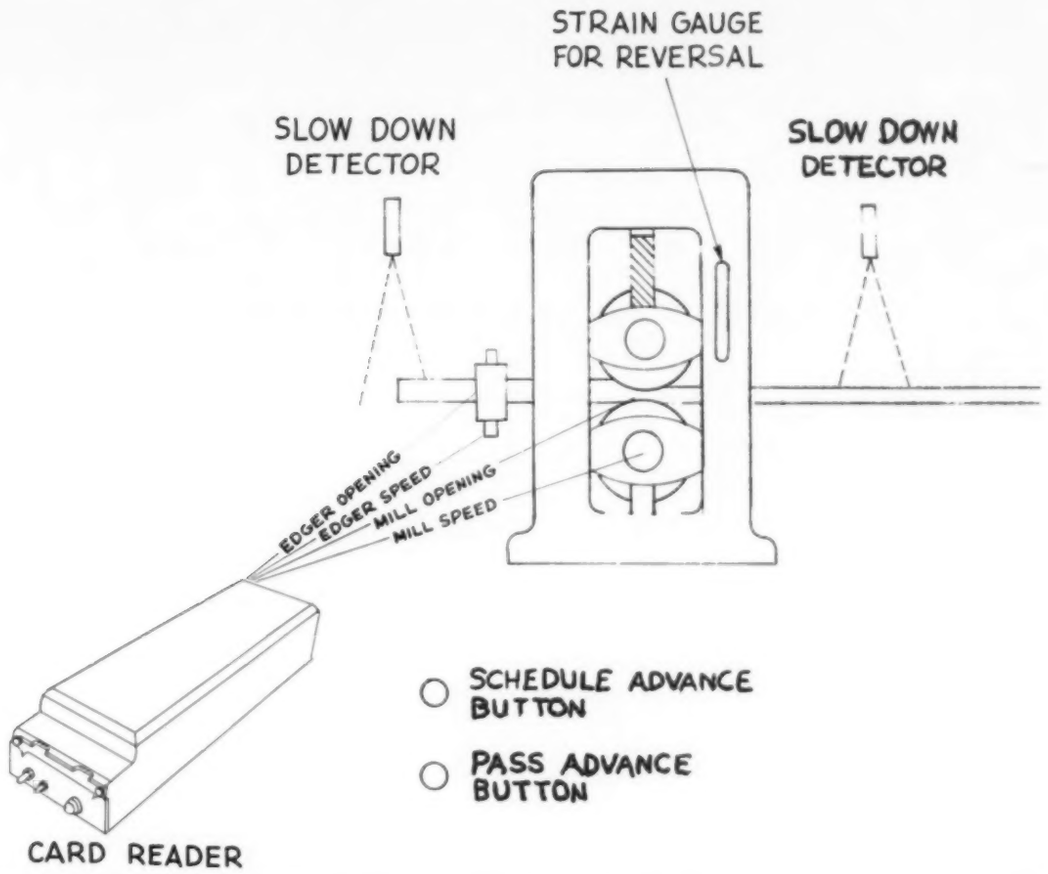


Figure 13 — Two modes of operation are indicated for this completely programmed mill. Automatic operation requires "schedule advance" initiation. Semi-automatic operation requires "pass advance" initiation.

now in operation in the United States (Allegheny Ludlum Steel Corp., McLouth Steel Corp., and Weirton Steel Co.). Three additional hot strip mills are now under construction with similar individual drive systems (Kaiser Aluminum and Chemical Corp., Republic Steel Corp., and Jones & Laughlin Steel Corp.). One mill (Fairless Works, U. S. Steel Corp.) has stand motors powered in pairs and several are arranged for occasional operation with the bus split into two sections.

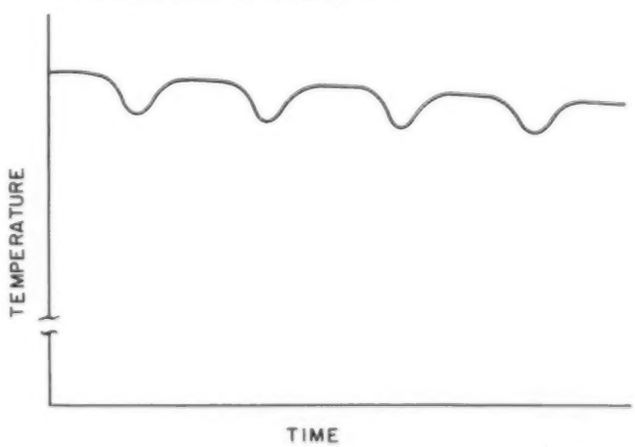
Either an individual rectifier or a generator may be used to supply d-c power to each stand motor. The Weirton hot strip mill utilizes an existing generator in parallel with either a new or existing rectifier. The choice between rectifiers or motor-generator sets depends primarily upon two factors: (1) necessity to vary speed by voltage when operating under load, and (2) an economic evaluation involving first, installation and maintenance costs, efficiency and power factors.

The Weirton hot strip mill has the largest total main drive horsepower of any mill in the world. The six stand motors total 31,000 hp with a conversion capacity of 27,000 kw. There are several mills with over 25,000 hp total. Loads on each pass may range up to 150 per cent of rated capacity. Time for a pass may be as long as 90 sec. Transient loads are imposed upon the stand power supply systems as the front end of the strip enters each stand and removed as the tail end leaves each stand. These transient load variations can affect gage of front and tail end of the strip and should be considered in overall system design.

Automatic gage and width control on hot strip finishing mills appears to be the most complicated of all automatic gage control problems. The problems of gage and width are somewhat interrelated and cannot be entirely separated. Gage and width both vary with tension. However, excessive variations in tension can cause undesirable variations in width. Variations in width and gage of hot bands used in high speed tandem cold strip mills can cause strip breakage, damaged rolls and result in considerable loss in production. Coils varying in width must either be side trimmed, inspected during pickling and rescheduled, or the tandem cold strip mill operated at reduced speed and production. Automatic gage control on tandem cold strip mills can correct for some variations in hot band gage, but cannot correct for or prevent possible mill cobbles due to variations in strip width.

Hot strip mill automatic gage control like any form of

Figure 14 — Temperature variations are shown for strip entering hot strip finishing mill.



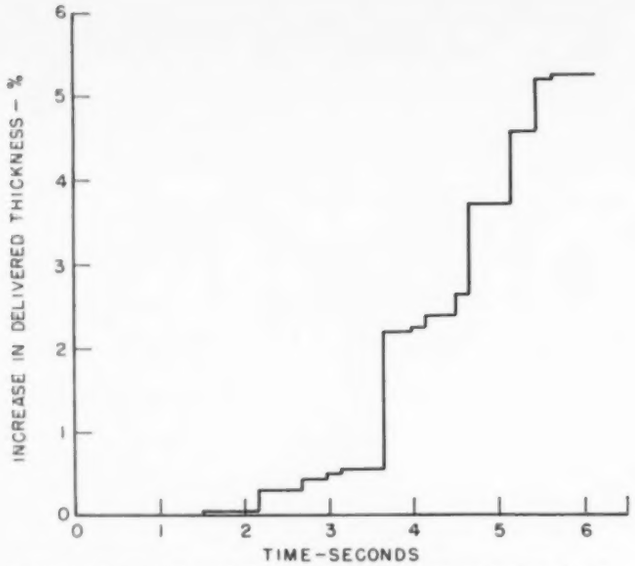


Figure 15 — Tail end delivered thickness of hot strip has been calculated from instant tail drops out of first stand.

automation must be reached through a process of evolution. Fundamental analytical work must be done and the tools and system components must be developed before gage control can be incorporated into such a complex drive system. Extensive basic analytical studies have been made by the author's company to determine the feasibility and relative merits of various systems. A paper summarizing the important causes of gage variation, the analysis and possible solutions by Mr. R. A. Phillips is entitled "Methods of Control of Strip Thickness on Hot Strip Finishing Mills," AISE Spring Conference, Cincinnati, Ohio, April 29, 1957.

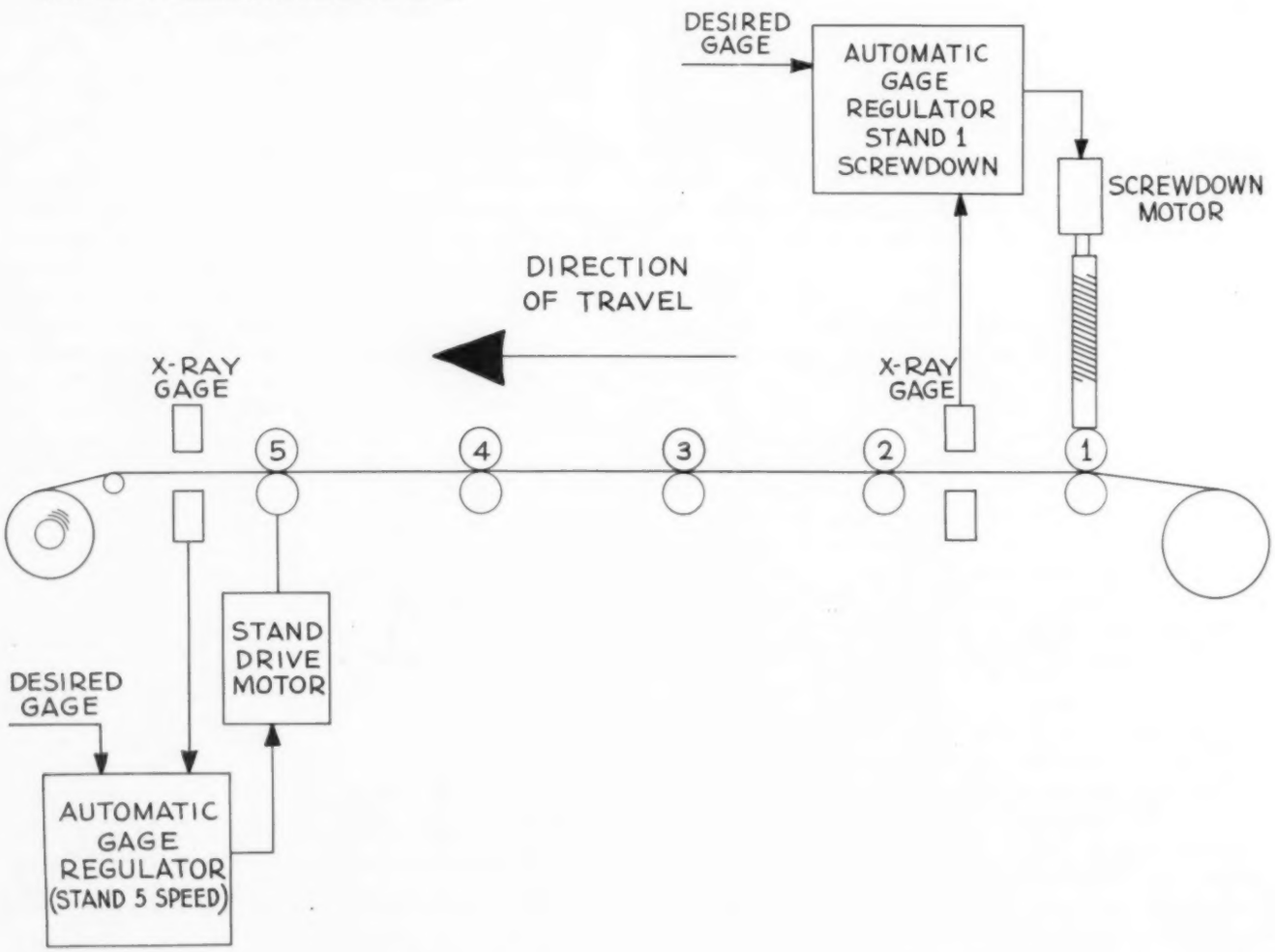
Mr. Phillips' analysis indicates that the most significant cause of finish gage variation over the main portion of the coil is variation in incoming temperature as typically shown in Figure 14. In other words incoming hardness variations are more significant than incoming thickness variations.

Mr. Phillips has also calculated the increase in thickness of the tail end as it leaves the various stands. The finish gage profile shown in Figure 15 was calculated on the basis that the interstand tensions prior to the strip leaving the mill were all 4000 psi. It was also assumed that the mill stand speeds remained constant.

The analysis referred to covers process and drive system factors since as discussed earlier they are inseparable on this and most steel processes. Gage control may be achieved by means of screwdowns, tension or combinations thereof.

The speed regulating systems and improved instrumentation on the Columbia Geneva Division, U. S. Steel hot strip finishing mill has been reported in another AISE paper "Application of Speed Controls for

Figure 16 — Finished strip thickness is automatically regulated to close tolerance through coarse and vernier gage control systems on tandem cold reduction mills.



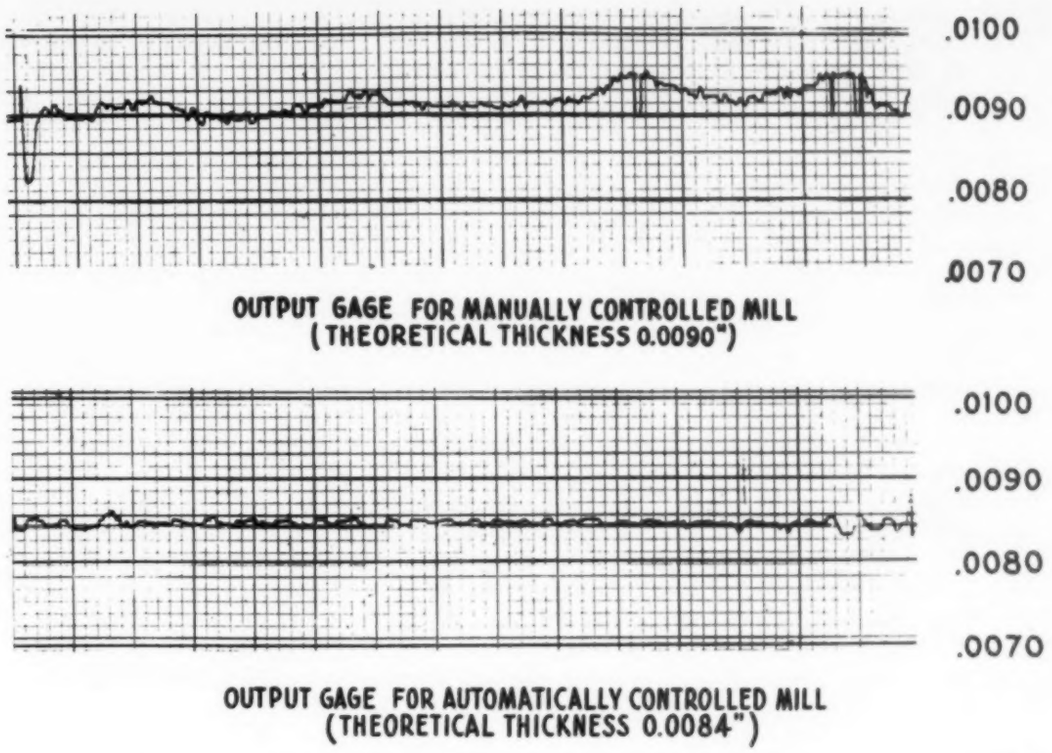


Figure 17 — Sections of record charts show variations in strip thickness out of stand No. five on a five-stand tandem cold reduction mill for manual and automatic gage control.

Hot Strip Finishing Mills," by George S. Koss and Louis E. Ringer, 1956 AISE Annual Convention. Similar speed regulators are also in operation on the 80-in. hot strip mill at Cornigliano, Genoa, Italy. Experience on both mills has been extremely gratifying and indicates definitely justification for the addition of such regulating equipment and instrumentation on other hot strip finishing mills as a first step towards automatic gage control. It is understood that several mills are considering installation of such equipment.

COLD REDUCTION MILLS

The advance in the art of cold rolling tinplate has been one of the most outstanding developments in industrial production. In twenty years there has been a change from rolling this product at several hundred fpm with an output of a few tons per hour to rolling at 5000 fpm or higher with an output of almost 1½ tons per minute with practically the same number of men. Today's mills with their many motors and many regulating control systems are operated entirely through push buttons and X-ray gages. They are outstanding examples of the automation that can be achieved with today's know how, and are truly the monarchs of all co-ordinated drives in industry.

The highest speed, highest powered tandem cold reduction mill is located at the Weirton Steel Co., Weirton, West Virginia. This mill has a total of 28,000 hp in d-c main drive motors and will finish tinplate thicknesses at speeds of up to 7020 fpm with strip thickness being automatically regulated through two X-ray gages and numerous transistor, magnetic amplifier and rotating regulating systems.

All new tandem cold reduction mills are being provided with automatic gage control. The presently accepted complete system of automatic gage control consists of two sections, a coarse system operating on the screwdowns of stand 1, and a vernier system operating on the speed of the fifth stand to change tension between stands 4 and 5.

The No. 1 or coarse gage regulating system is designed to reduce large thickness variations to small thickness variations. These small thickness variations are reduced by the operation of the No. 2 or vernier regulator.

The No. 2 or vernier gage system is integrated into and works through the feedback control systems associated with the last stand drive system. Thickness of the finished strip can be controlled over limited range by varying stand 5 speed, and the tension between stands 4 and 5. The vernier gage control system uses this principle to control the final gage of the steel strip. The system and operating performance are described in the 1956 AISE Annual Proceedings, p. 674, "Development of Automatic Thickness Control for Tandem Cold Reduction Mills," by R. W. Holman, H. S. Maxwell, and M. W. Cannon.

Numerical programming, data recording and data processing are being applied on tandem cold strip mills to various degrees. One mill will use punched card presetting of automatic gage control functions. Several of the mills will automatically record information pertaining to finish gage variations from preset tolerances. It is possible to record the number of feet from the beginning of the coil at which the gage comes within tolerance as well as the point at which gage again goes heavy or light. The number of feet of on-gage material, heavy material and light material can be totalized and recorded at the completion of the coil. Combinations of standard accounting cards, punched tape and electric typewriter readout are being furnished.

PROCESSING OF STEEL STRIP

This is the area where continuous automatic production is making great strides. The processing of steel

strip has progressed from the batch process with relatively slow speed lines performing one operation such as shearing, pickling or side trimming to continuous lines performing many operations at strip speeds in excess of 1000 fpm. Both mechanical and electrical advancements have given continuous pickling and cleaning lines, continuous galvanizing, and various continuous chemical treating, bonderizing and coating lines.

On a tinning line, the ultimate in automatic inspection and classifying equipment is used. The pinhole detector detects holes in the strip of the order of one mil in diameter; beta-ray or X-ray gages measure tinplate thickness and steel thickness and now electronic tinplate inspection equipment automatically detects surface flaws of various sizes and optical contrast.

Signals from these inspecting devices initiate marking or diverting of off quality material. The addition of numerical data recording, processing and computing equipment would give a means of continuously comparing actual quality control with expected or normal quality control. Printed read out could be automatically and simultaneously furnished to operators along the line permitting them to make adjustments to controls. Ultimately with experience, controls might be automatically reprogrammed.

SUMMARY

Thirty-five years ago close to 90 per cent of the power applications in the steel industry were electrified. Yet power consumed per ton of steel output has steadily increased. New electron systems and products have contributed to this increased electrification and to increased productivity of steel plant processes. There is every reason to believe that this trend will continue. Each new mill and each new processing line will be expected to produce more steel of closer tolerance and do it more automatically. Programming through business machine cards and tapes, automatic data logging and processing, and even some computing systems are being applied in the steel industry today. Planning for new process equipments and modernization of existing facilities should be based on full utilization of the rapidly expanding systems technology so that the systems installed will make the proper contribution to tomorrow's operations.

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Prospects of Growth— Western Steel Industry

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Fontana, Calif.

▲ THE story of rapid growth in the West is certainly not new to those who live and work there. Everyday examples of this can be seen in the fabulous growth in new homes, factories and public works—and in crowded freeways. In spite of the problems created by rapid growth, growth is the basis for industrial progress, new job opportunities and better living levels for everyone.

HISTORICAL WESTERN GROWTH

Before attempting to show the special importance of growth to the western steel industry, take a brief look at some of the more important measures of western growth. The most basic element of growth is population. In 1940 the seven western states had a population of 11,500,000. During the war years 3,500,000 people were added. The West has not only supported the war increase, but also added nearly twice that number to the population since the end of the war. In total there has been an increase of 9,000,000 people on the west side of the Rocky Mountains since 1940. This great movement to the West is not a new phenomenon, it dates back to the gold rush days. California has always been the leader in this growth. During the decade 1940 to 1950 this state set a new record with a total influx of 2,700,000 people. This growth record promises to be equaled during the present decade, 1950 to 1960.

An increasing population itself creates needs for goods and services of all kinds, but before population can increase there must be opportunities for employment. As measured by the increase in manufacturing activity, the West has provided jobs to sustain rapid growth. Manufacturing employment in the seven western states has increased from 700,000 in 1940 to over 1,600,000 in 1956.

But, these changes in population and employment tell only part of the story. Because productivity has been increasing at about 3 per cent per year, western production has increased three-fold, while population and employment have only doubled.

More employment and greater productivity have rapidly increased western income. In the five years 1950–55, personal income in the seven western states has gone up by $13,000,000,000—an increase of nearly 50 per cent. This has come on top of the rapid increase of the preceding ten years.

. . . . western growth pattern indicates that between now and 1965 some $1,300,000,000 must be spent to add new facilities with an ingot capacity of about 4,400,000 tons . . . .

REASONS FOR GROWTH

Even to westerners who are familiar with the great expansion of this region, the facts reviewed are startling. It is difficult to see at a glance the reasons behind this rapid growth. Perhaps the primary reason is that the West is the last of America's physical frontier and as a frontier it provides the expectation of greater and more rapid advancement which has always lured the pioneer. The fact that these expectations are often realized has caused them to be a continuing factor attracting new population.

Climate not only plays an obvious role in bringing in new population, but it also forces some industries such as fruit processing to locate here and attracts other industries such as aircraft, electronics and many

manufacturers of small, high value products. It is probably going too far to relate the favorable climate to the high birth rate of recent years, but the vigorous life that the climate encourages has a direct bearing on the birth rate.

Another reason for western growth which deserves mention is the advance in transportation, especially widespread use of the family automobile. Automobiles have not only made migration to the West easier, they have also made it cheaper.

There seem to be good reasons for people to want to come. Look at some of the things which have made it possible for the West to support and sustain its growth. As a frontier area the development and utilization of resources plays an important part in ability to grow. The large lumber industry of the West is the outstanding example of growth based on resource utilization. Another such development is the growth of a western steel industry using western raw materials. Other industries, such as aircraft and motion pictures located in the West to take advantage of the climate. In this sense climate may be viewed as a resource.

The growth of all these industries enlarges the regional market, and thereby attracts other firms in industries which are primarily directed toward the market. The mere fact that there is growth creates need for large amounts of construction activity and a larger labor force. In addition, the great strategic importance of the West has led to a high volume of Government spending in this region. In short, western growth is largely a self-reinforcing process. An initial push multiplies itself in many ways.

What does this record of expansion suggest for the future? The industries already located here will continue to find the West an advantageous location, and they will continue to expand. The growing size of the western market will attract new industries, and these industries will expand. Government expenditure will continue to be large, and will be increasingly centered in aircraft, missiles, electronic devices and research. The concentration of these defense industries in the West will be especially important. Heavy construction outlays will be a necessary part of this pattern of development. To top all this, it may be recalled that even in the 1930's western growth continued. No matter what the course of future years, growth in the West appears to be one of the surer forecasts.

Much of the western growth has directly created markets for steel mill products. The recently completed Census of Manufacturers indicates that the West has experienced an increase of 84 per cent in metalworking employment since 1947. By comparison, the national increase of the same period of time was only 11 per cent. No wonder the need for expansion is particularly acute in the western steel industry.

This story of growth discloses the basic reason for the rapid development of the western steel industry. Economic growth is of particular importance to the steel industry because of the nature of the uses for steel mill products. Demand for steel is created only in small part by replacement of facilities which wear out. The major markets for steel—construction, capital equipment and durable consumer goods—are largely created by change or growth. In a static economy demand would be largely for replacement, and consequently requirements for durable commodities would be extremely low. The western environment is dynamic, not static, and the demand for steel reflects this fact.

HISTORICAL WESTERN STEEL MARKET

Generally, the economic growth of the West explains the need for increasing quantities of steel. However, the growth of the steel market is staggering. In 1940 western steel requirements were estimated to total 2,500,000 tons. By the end of World War II, normal peacetime requirements had grown to nearly 4,000,000 tons. Last year about 6,500,000 tons were received from mills by western industry. Look a little more closely at this market to see the specific patterns of growth which have created the new demand.

First, on any list of causes for high steel demand in the West is the very high level of construction activity which the West supports. On the basis of building permits the West accounts for 23 per cent of national building construction. This area holds little more than 12 per cent of the national population. Clearly, the construction industry is about twice as important in the West as nationally. In addition, a large portion of the nation's heavy construction is located here—far more than the population would suggest. In fact, Southern California alone records $312,000,000 of engineering construction during the first nine months of 1956, 15 per cent increase over the previous year. High levels of construction result in large requirements for plate, both standard and wide flange beams and reinforcing bar.

The West has always been a major consumer of tin plate. The western market now accounts for almost one-fourth of national metal can requirements. This is primarily a result of the concentration of fruit and vegetable production and consequently food canning in this region. Other distinctive activities which have created demand for steel in this area, particularly tubular goods, are petroleum in the Southern and Central sections of California, and use of natural gas as a primary fuel.

The western economy is still below the national average in steel required for such mass production industries as major household appliances and automobiles. The principal significance of this is that local requirements for light flat rolled products are relatively low at the present time.

One noteworthy characteristic of steel demand in the West is its stability relative to the national market. The differences in end uses just mentioned account for part of the greater stability. The other part of the answer lies in the more rapid rate of western growth which tends to offset short declines in the market. As the western market becomes more like the national steel market, some of this relative stability will be lost.

Some time will pass before all of the industries not now located in the West open western plants. Perhaps some of them will never move from their historic locations in the East. But, many of them will establish branches here and western firms will expand their product lines and plant capacities. These developments will continue to expand the steel market even

more rapidly than the area's general economic growth.

Another avenue of expanded steel use, which is particularly unique, is the aircraft and missiles industry. Historically, western aircraft production has required little steel. In fact, even the largest airframe manufacturers buy but little steel in mill quantities. But recent developments point to the use of much larger amounts of steel in aircraft and missiles.

The western steel market, like western population, is spread quite unevenly throughout the region. Southern California accounts for between 40 and 45 per cent of the total. In some steel products the concentration is even greater. For example, over half of the western light flat rolled market is located in Southern California. Over 55 per cent of the western market for standard and line pipe is also there. Northern California accounts for an additional 35 to 40 per cent of western steel consumption. The large size of the Northern California market results largely from that area's high consumption of tin plate.

The Pacific Northwest accounts for about half of the balance of western steel consumption. Much of this Northwest market stems from heavy construction and development projects. This is well illustrated by the fact that 25 per cent of the market for concrete reinforcing bar is located in the Pacific Northwest. The balance of the market is located in the mountain states.

STEEL PRODUCTION IN THE WEST

The western steel industry has been growing since the days of the '49ers when the first production facilities were built to supply the miners with construction materials, wagon parts and mining equipment. Later, the small steel producers in the West expanded to meet the needs of the railroad and shipbuilding industries, and to supply the small, but growing complex of western manufacturing industries.

From 1936 to 1940 western consumption averaged a little more than 2,000,000 tons a year. Most of this was in the form of rails, tin plate for food cans, tubular goods for oil and water transmission, and bars and other products for the then small manufacturing and fabricating industry.

Local mills supplied only a small part of the area's modest steel requirements. About three-quarters of the West's steel was supplied from the East or from foreign countries. The eight semi-integrated mills on the Coast had a capacity of about a million tons. Half of this capacity was for concrete reinforcing bars and other bar products. The balance was for relatively small tonnages of structural shapes, hot rolled sheets, railroad tie plates, wire products and a little hot dipped tin plate.

Although steel production in the West advanced with economic growth of the area, the industry was severely limited in both the range and volume of products it could supply until after World War II. The industry's capacity is still well below market demand, but great advances have been made since the war in range of products and in total output.

Western steel requirements skyrocketed with the advent of World War II. In fact, steel requirements almost doubled during the first year of the war, and they continued to increase through the war period. The vast quantities of steel needed for the shipbuilding program, coupled with the distance from eastern mills, required that western steel production be increased immediately. The most spectacular result of this need was construction of two new fully integrated mills. One was, of course, the Fontana works of Kaiser Steel Corp., and the other the U. S. Steel Corp. plant at Geneva, Utah. In addition, western capacity was increased by construction of several smaller non-integrated mills and expansion of existing plants. Among the new mills were: Oregon Steel Mills at Portland, Pacific States Steel Corp. at Niles, and steelmaking facilities by National Supply Co. at Torrance, and Isaacson Iron Works, Inc., at Seattle. The total affect of all these changes was to raise western ingot capacity to 3,750,000 ingot tons per year.

The two new integrated steel plants were large in terms of ingot production with combined annual capacity of 2,000,000 tons, but they were limited to rolling mill facilities necessary to produce plate and structurals for ship construction. As a result, there was concern about the ability of western producers to diversify into products needed in a peacetime market. Even greater concern existed regarding the ability of the western market to absorb the potential output of these proposed new facilities, if the necessary diversification should be accomplished. On both counts the West has proved itself in the postwar years—surpassing the expectations of even the most optimistic forecasters.

POST WORLD WAR II DEVELOPMENT

Western manufacturers looked toward the new steel plants as a means to secure the materials needed to manufacture products for this growing population center. At the end of World War II the West's need for construction of all types was acute. Roads, schools, office buildings, plants and other facilities were needed not only to provide for new population, but also to compensate for the low output of the preceding 15 years of depression and war. A revolution in the use of liquid fuel and natural gas required pipe line construction far exceeding any previous record. In addition, utilization of wartime constructed manufacturing facilities posed a challenge to western producers. Vast expenditures for new plant facilities and equipment were required to permit the West's war based industry to participate in supplying the civilian market.

Western steel producers recognized that a great potential existed for their plants. Although in the steel industry the extent of this potential was underestimated, we thought we were being optimistic. In retrospect we see that our early forecasts grossly undershot the mark. At any rate, forecasts such as ours furnished a basis for the postwar expansion programs which have played an important part in "building the West."

The problem of postwar reconversion was severe for the large, fully integrated mills. The Fontana plant will serve as an example of the diversification that was necessary. At the end of the war, the plant was capable of producing plate, standard structurals and some bar products. The first step was to relocate and rebuild by the addition of new housings, and strengthening the

motor of the 36-in. blooming mill to make it equivalent to a 40-in. bloomer. At approximately the same time, a finished steel warehouse 100 × 350 ft was added to the structural mill building. Originally part of the merchant mill, the skelp mill was then placed in operation. The addition of four stands to the merchant line was part of this conversion. Immediately following was the start-up of the continuous weld pipe mill and the cold rolled strip mill. Following this, the seventh open hearth and soaking pit battery No. 7 were started. In April, 1949, a second slab heating furnace was added to the plate mill to increase the capacity of this unit. In the latter part of 1949, blast furnace No. 2 was blown in and the third battery of coke ovens was placed in operation. Within a matter of months another major step in diversification took place with the start-up of a four-stand, four-high, 86-in. hot strip mill and an electric weld pipe mill for production of line pipe up to 12¾ in. Open hearth No. 8 was tapped in May, 1951. Since then the almost continuous expansion has greatly increased the size range volume and variety of mill products rolled at Fontana. The plant now has a third blast furnace, a ninth open hearth, a tin plate mill and a 46-in. blooming mill which replaced the modified 36-in. mill. These developments of the postwar years resulted in a much wider range of products being offered to western steel users and a larger quantity of steel being produced in the West from western raw materials.

In terms of tons, capacity has more than doubled—from 750,000 tons of ingots in 1946 to about 1,600,000 now.

While these developments were taking place at Fontana, other western producers were also expanding to meet the demands of the growing market. U. S. Steel Corp. developed tin plate and cold strip mills at the Pittsburg works in conjunction with expansion facilities for hot bands as well as plate and hot rolled sheet at their Geneva, Utah, plant. The semi-integrated producers such as Bethlehem Pacific Coast Steel Corp., Pacific States Steel Corp., Southwest Steel Rolling Mills Inc., and Oregon Steel Mills expanded and improved their plants to produce a larger variety of better quality products.

The new products offered by local mills after this diversification were standard and line pipe from ½ through 36 in., cold rolled sheet, continuous galvanized sheet, cold rolled strip, wide flange beams, electrolytic tin plate and cold finished bars.

In spite of these attempts to meet the West's expanded need for steel the area's deficit continued to be about 2,000,000 tons which had to be supplied by imports from the East or from foreign sources. This deficit not only still exists, but is greater than ever. In 1956 we estimate that the amount of mill product which was brought in from other sources was 2½ to 3,000,000 tons.

The reason for this deficit in western steel production is quite basic. The market for steel products in the West grows so rapidly that the producers have been unable to close the gap. This is not because of failure to gage the potential. It is a result of the difficulties involved in building new capacity. The steel industry of the West can expand by enlarging existing plants, building new integrated mills, or by building semi-integrated mills relying on scrap as a source of metallics.

Fortunately, the steel industry has been able to expand output greatly by making additions to existing mills. In this way the costs of increased capacity have been greatly reduced. But the amount of growth by piecemeal additions to existing plants is limited in spite of ingenuity of steel engineers. Eventually the industry will be faced with the necessity of building completely new plants.

Growth by semi-integrated plants is limited by the availability of scrap and the price that must be paid for scrap in relation to steel prices.

An example of growth by expansion of a semi-integrated mill is provided by the Seattle plant of Bethlehem Pacific Coast Steel Corp. That company recently announced plans for installation of two new electric steelmaking furnaces which will nearly double the plant's steel capacity. These new electric furnaces will replace five small open hearth furnaces. The installation of the furnaces will be accompanied by replacements and improvements to the rolling mills which will enable the plant to produce a larger range of bars, universal mill plates, and structural shapes.

The basic problem of scrap prices to expansion of semi-integrated mills has been approached by Pacific States Steel Corp. by the recent announcement of the purchase of a 300-ton per day blast furnace.

Construction of new large completely integrated mills or big increases in the capacity of the two existing ones is dependent upon obtaining adequate iron ore and coking coal and money.

Steelmaking raw materials, although not plentiful, are more abundant than anticipated ten years ago. The best example of this is Kaiser's Eagle Mountain mine. In 1948 the State of California Department of Mineral Resources estimated that there was about 43,000,000 long tons of iron ore containing 30 per cent or more of iron in the Eagle Mountain area. If this had been accurate, Kaiser Steel Corp. would now face a serious ore problem, but subsequent exploration has indicated that these reserves are many times the original estimates.

Ore bodies of commercial size occur in Shasta County, in the Sierras and at scattered locations in the northwest as well as in the Mojave Desert, and in Arizona. An alternative source of iron would be the Utah ore bodies which require a long and expensive rail shipment to reach the Coast. None of these other known iron ore deposits approach Eagle Mountain in size, and possibly none of them are large enough to provide adequate support for a large integrated plant.

Abundant coking reserves have been determined in the Utah, Colorado and New Mexico area that can support large scale ironmaking operations.

There is further encouragement in the fact that South American ore can be delivered to this seaboard about as cheaply as to the Atlantic seaboard, although the complementing domestic coal deposits are further inland than is the case on the East Coast.

In effect, raw materials are and will be available in this area, and we at Kaiser are particularly fortunate in this respect; but generally the economic assembly of these materials at a plant well located with respect to market is a formidable problem.

Financing capital expansion has always been a

problem in the steel industry and the condition previously referred to makes it particularly noteworthy. It is the availability of capital in this area that is now the major factor setting the course of western steel production. The steel industry is by its nature a high capital cost business. New technological developments and price increases have greatly increased capital costs. It is currently estimated that a completely new, fully integrated steel mill would cost between $300 and $350 per ingot ton of annual capacity. Thus, a mill the size of the present Fontana works before the current expansion program capable of producing a little over 1,000,000 tons of finished products a year would cost about $500,000,000.

In spite of problems such as we have just explored, substantial increase in the capacity of integrated western mills will be a necessary feature of the industry's long-run expansion. The area's steel deficit and rapid growth make the West a favorable area for such expansion.

There are indications that U. S. Steel Corp. is thinking of a new fully integrated plant in the San Francisco area. Various proposals have been made for the construction of large mills in Northern California. Expansion now underway at Fontana will represent a major addition to western capacity.

Construction has already started at our mills on facilities for the production of about 700,000 tons more ingots a year in oxygen steel furnaces, a slabbing mill, a hot strip mill separate from the plate mill, and additional tin plate facilities. Although we are just started on this program—it is less than 10 per cent complete—we are planning another one—another 700,000 tons of oxygen ingot capacity plus a fourth blast furnace, coke ovens and a 140-in. 4 high plate mill. If we are able to finance this—and proceed with both programs—we will nearly double our capacity within two years.

Whether increased production stems from new mills or from expansion of existing ones, the changing nature of the western market will dictate the course of the expansion. The growth of the West is accompanied by diversification of industry and an increase in large scale manufacturing operations. This is reflected in relatively greater growth in the market for light, flat rolled products and for a greater variety of bar products. Although, demand for all steel products will grow, larger increases will be recorded in these categories. Unusually large investment costs, even for the steel industry are needed to produce flat rolled products efficiently. Wide sheets are the outstanding example of this type of product. Large mills capable of high speed operation using large slabs are essential to roll wide sheet economically. On the other hand, bar products may be produced with smaller, less costly facilities in both the quantities and qualities required by modern industry. Thus, both the small and large steel producers should participate in the shifting growth pattern of the western steel market by supplying the mill products which are relatively more adaptable to their facilities.

The future distribution of steel consumption within the West will also influence the characteristics of new mills in this area. The expectation that future growth will be shifting northward in the coastal states and into the mountain states suggests that a considerable dispersion of the steel market will take place. This is of consequence for the expansion prospects of the industry. The likely locations for producing mills are limited by the availability of raw materials and transportation facilities as well as by the concentration of the present day market. As new industry develops away from the present steel mills, we may expect new plants to be located in the more rapidly growing areas within the limits of raw material assembly cost.

The current steel deficit of the West is concentrated in products such as continuous weld pipe, wide flange beams, tin plate and sheared plate. In addition to providing for the change in product mix resulting from regional growth, the western steel industry must reduce the deficit of the products in shortest supply from western sources. Advancing on both these fronts at the same time requires that a wide range of products be included in expansion plans.

In more specific terms, western requirements for steel are expected to reach a total of 7,740,000 tons by 1960 and by 1965 it may be expected that as much as 10,000,000 tons of steel mill products will be used in the West annually. It should be emphasized that this represents potential market; realization of the potential will require concerted effort from all sectors of our industrial economy.

For western mills to provide for all the market growth expected from now till 1965, a tremendous expansion would be required. The additional steel mill products needed in the West from now to 1965 will total approximately 3,200,000 tons. In terms of ingot capacity, at 100 per cent operation, this is equivalent to 4,400,000 tons annually—or two mills as large as the Fontana plant.

Another way of looking at the expansion required by the West's growing market—and the way the steel industry is forced to look at it—is in terms of cost. The addition of 4,400,000 tons of ingot capacity would require new investment of slightly more than $1,300,000,000. This means an outlay of new facilities of over $160,000,000 annually until 1965. Some of this capacity can be obtained more inexpensively by expanding existing mills, but is doubtful that it could all be met without the construction of completely new steel mills. Thus, most of the challenge of the growing market has yet to be met.

In short, the future of the western steel industry is bright. Western growth has been twice the national rate and shows every prospect of continuing to exceed national growth. The West has advanced more rapidly in manufacturing and especially in metalworking. These patterns, too, promise to continue.

The West's growth poses a challenge to the western steel industry and supplies it with an unparalleled opportunity. In spite of a limited number of sources of raw materials and fabulously large capital requirements, the steel industry must provide sufficient steel to sustain the region's growth.

While the western steel producers have been expanding rapidly in the postwar years, the biggest part of the challenge is yet to be met. For our part, we accept the challenge gladly, and we are sure that our competitors feel the same way. Every effort will be made to secure the materials and the money necessary to build a bigger and more promising future.

Recent

By CHARLES R. TAYLOR
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▲ HYDRAULICS in industrial applications have made phenomenal advances in the past decade. Engineers are becoming increasingly aware of the advantages of this form of power to solve complex drive and control problems. The majority of installations, however, have been in pump-cylinder, or linear motion applications with only a small percentage of the total installed pump horespower being directed to rotary power transmission. This is particularly true of the steel industry where considerable use has been made of hydraulics in extrusion, molding, and pressing operations, with a very low percentage of installed horsepower applied to rotary power transmission. This latter type of hydraulic power is covered in this discussion. We believe there is an unlimited future for rotary transmissions as hydraulic units are designed with desired characteristics to give high transmission efficiencies, over wide speed ranges, at the required horsepower. This applies basically to hydrostatic hydraulics and positive displacement units rather than the slip type such as torque converters or fluid couplings, which have a relatively narrow efficiency band in relation to speed.

One of the reasons for the slow progress of rotary transmission in comparison to linear motion, is that it has only been in the last fifteen years that hydraulic motors with the desired characteristics have become available.

This is particularly true in steel mill applications where horsepowers in the range of 50 to 500 or higher are common. Table I may be of interest. It shows the hydraulic horsepower ranges used in 1955 in terms of estimated total pump output horsepower for twelve selected industries listed in Table II.

Of a total pump output horsepower of well over 4,000,000 in the industries studied only 103,000 or 2.36 per cent was applied in transmissions. It shows that the most prevalent horsepower range in cylinders was from 5 to 25 while the highest transmission usage was in the range from 25 to 50-hp.

Table II shows the distribution of the horsepower used in 1955 by the selected industries. Again there is no comparison between total output horsepower of cylinder and transmission applications. The largest user of transmission horsepower, according to the survey, was heavy construction equipment which accounted for 69,650 hp or 67 per cent of the total transmission horsepower used in these industries.

It is necessary to sell the ultimate consumer on conversion to hydraulics before a demand is created of the equipment builder who will eventually change machine design to comply with customer demand. This requires considerable missionary work in selling the idea of conversion, particularly in the higher horsepower ranges where capital investment is a consideration in addition to expensive engineering time. Consequently, the approach must be vertical by industry, rather than horizontal for all industry which would result in a multitude of development engineering projects in the engineering department, with a minimum of progress in any one industry.

The following are some of the advantages of fluid power transmission:

1. Infinitely variable speed with simplicity of control.
2. Instantaneous reversibility without shock or damage to the power equipment.
3. Positive braking.
4. Torque amplification.
5. Safe operation of explosive atmospheres or hazardous locations.

TABLE I
Pump Output Horsepower by Size Range

Unit horsepower	Cylinder application, hp	Transmission application, hp
5.0 or less	123,917	6,279
5.1 to 25.0	3,429,326	37,637
25.1 to 50.0	743,300	54,953
50.1 to 75.0	55,970	4,190
75.1 to 100.0	6,965	...
100.1 or more	...	...
Total pump output horsepower	4,359,478	103,059

TABLE II
Hydraulic Horsepower Ranges by Industry

Industry	Cylinder application, hp	Transmission application, hp
Agricultural machinery	2,612,000	2,900
Construction equipment	925,350	69,650
Fork lift trucks	600,000	...
Machine tools	135,285	9,715
Hydraulic elevators	49,700	...
Oil field machinery	16,660	2,315
Printing presses	9,700	...
Mining machinery	1,800	7,010
Oil and gas producers	...	8,332
Sawmill machinery	5,650	...
Marine equipment	2,220	2,750
Textile machinery	1,113	387
Total	4,359,478	103,059

. . . . inherent advantages of hydraulic drives such as variable speed with simple control, torque conversion, safe operation, simplicity and economy, offer many possibilities for useful steel plant applications . . . .

Applications of Hydraulics to steel mill drives

6. Ease of adaptability to remote power locations.
7. Savings in space and weight with comparable horsepower transmission equipment.
8. Operation of multiple hydraulic motors from one pump and prime mover.

With such a list of positive advantages it would appear that there should be a considerable demand for hydraulic transmissions. Such is not the case in the steel industry because conversion from existing drives is costly and new mills are few and far between.

One item not included in the above list of considerable importance is the comparison of the cost of hydraulic transmission with electric or mechanical. This of course varies from installation to installation. For example, take the specifications for a paper finishing machine. The drive roll must have controlled acceleration to top speed, operation at top speed for a limited period of time and controlled deceleration. The complete cycle of operation is held within an 18-second period.

A mechanical drive in this instance was impractical. The electric drive required a-c d-c generator set to obtain the variable speed and electronic control at approximately twice the installation cost of the hydraulic drives. This ratio usually applies where variable speed with precision control or torque or speed is required on a cost comparison between hydraulic and variable speed electric and electronic control. On the other extreme is a small sawmill. Here the drive is mechanical and consists of an internal combustion engine as a prime mover with the speed of the carriage being controlled through manual operation of an idler pulley on a belt drive. In this instance the hydraulic drive is considerably more of an initial investment than the belt, but increase in production from simplicity of control together with the elimination of maintenance and belt replacement soon justifies the additional initial expense of hydraulics.

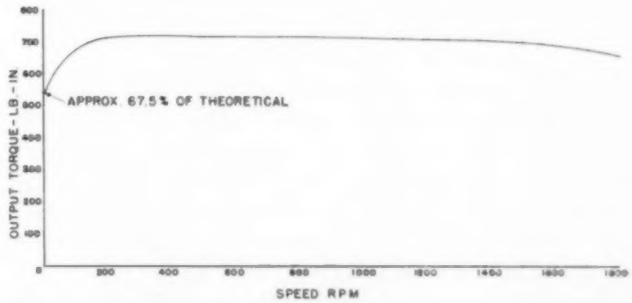
Where multiple hydraulic motors can be operated from a single pump station, and where operation of the equipment is in a hazardous area, variable speed hydraulic drive, direct-connected to the load can be furnished at no more expense than constant speed explosion proof electric motors with gear reducers. This cost comparison was made on a battery installation of agitator drives in a chemical plant. Such cost comparisons must be made on the basis of ultimate results in addition to initial investment.

The hydraulic units available for hydrostatic transmissions generally fall into four classes: (1) gear; (2) vane; (3) piston, axial or radial; and (4) other types—rotary vane, rotary piston, and screw type.

Gear units in general are in the 1000-psi class, though some run to higher pressures with consequent low life. They can be used as fluid motors, but at low efficiencies and excessive noise. In general all gear type fluid motors have a minimum speed between 100 and 500 rpm. Furthermore they have a low starting torque. On the credit side, the gear unit is inexpensive, compact, and almost universally available.

Vane type units are found in the 1,000 to 2,000-psi pressure range. The tangential vane type is nonreversible, while the radial type can be reversed. All vane units however depend upon centrifugal force and hydraulic pressure and/or springs behind the vane to force them out to the eccentric ring. This enforces mechanical friction and creates wear. In addition, their speed range is limited due to the centrifugal force required to throw the vanes into position at low speed,

Figure 1 — Typical performance curve for vane type fluid motor.



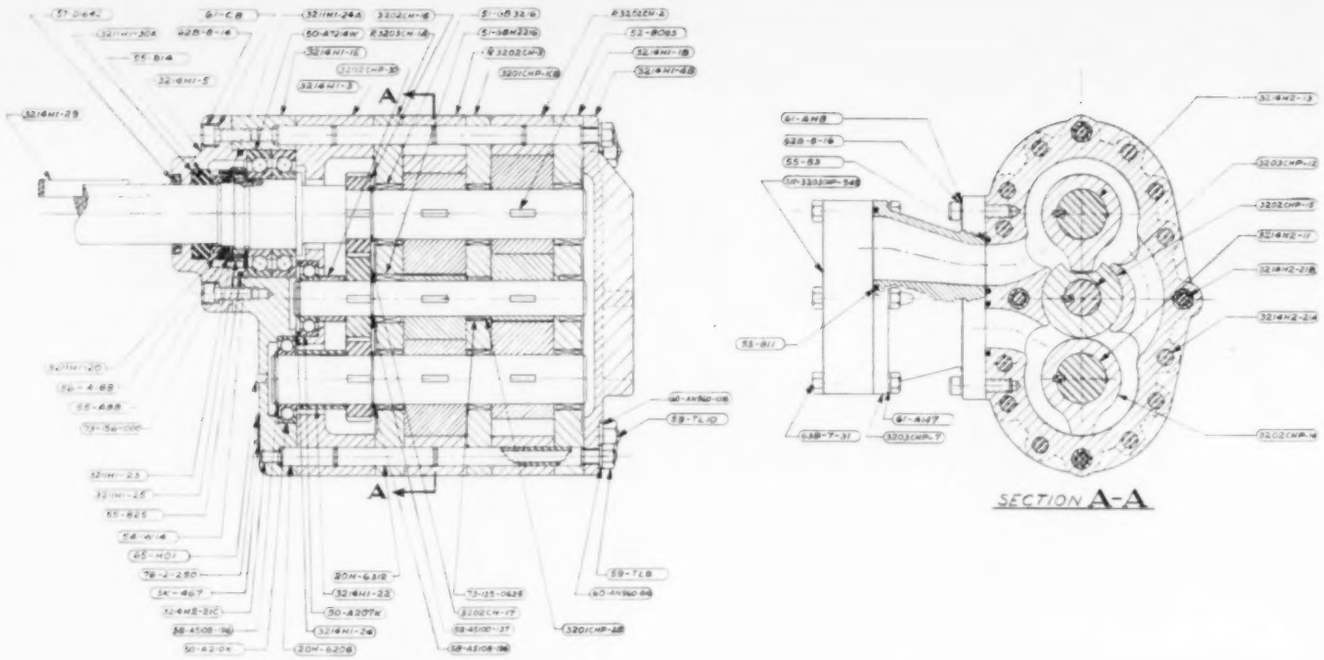


Figure 2 — Sectional assembly drawing shows the rotary piston design.

and the peripherial tip speed of the vane at high unit speed. On the credit side, vane units are generally inexpensive particularly in the 1000-psi class.

Piston type units, both axial and radial, are in the same category as to price and performance, but pressures reach out to 3000 and 5000 psi though these ratings are not for continuous duty. In a measure the piston type unit performance is very good, though they are delicate and not suitable for continuous rugged service. When high speed is involved, the piston unit is under a handicap since the cylinders cannot take or discharge oil fast enough in reciprocating motion.

Screw type units are good quiet running motors or pumps and can deliver high volumes. However, due to the necessity for elongating the screws for additional sealing, practical operating pressures for these units are in the range from 300 to 500 psi.

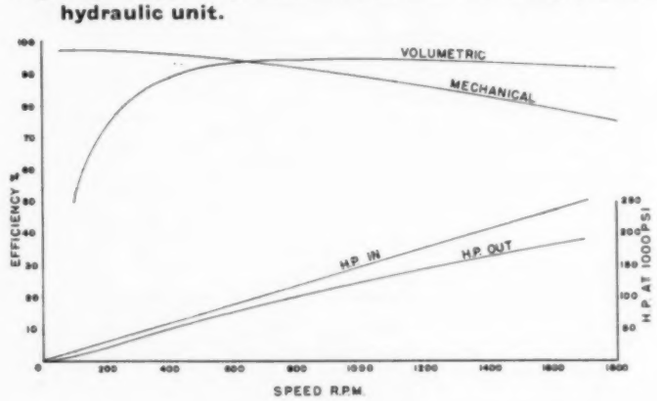
Common to all the above mentioned units when operating as hydraulic motors is the fact that their starting torque is below their running torque efficiency. This necessitates their operation at fairly high speed to overcome the mechanical losses inherent with metal to metal contact and sliding surfaces when speed is reduced. These units are normally designed for peak efficiency between 1200 and 1800 rpm, and usually require a gear reduction between the motor and the work load if slow speeds are required. Normal transmission efficiencies with these units including pump and motor are in the range of 60 per cent with few combinations of units ever going above 65 per cent overall. Also they are designed generally for the lower horsepower requirements.

Figure 1 shows a typical curve of the operating characteristics of this group. They have the inherent characteristics of a drop in mechanical or torque efficiency as speed is reduced. Starting torque is of course of the utmost importance in transmission application, and while these units make excellent pumps and find a ready market in cylinder application, their limitations when applied as hydraulic motors are obvious. On the other hand, these designs have been available for a number of years and have been applied with some degree of success in transmission applications in conjunction with various types of speed reduction units. It therefore was necessary, if the transmission market was to be further developed, to produce a hydraulic motor designed to overcome the limitations of the aforementioned units. Two such designs to the writer's knowledge are now on the market, the rotary vane and the rotary piston type of hydraulic motor or pump.

Figure 2 shows the rotary piston design. The largest single advantage to this unit as a motor is the fact that there are no contacting or rubbing surfaces. All rotating parts are mounted on anti-friction bearings with a resultant high mechanical or torque efficiency at low speeds. Maximum torque is obtained at "stall" conditions. Capillary sealing with oil viscosity control produces high volumetric efficiencies.

Figure 3 is a characteristic performance curve on this design. It will be noted that there is an extremely wide speed range with essentially constant torque and volumetric efficiency. This of course is ideal for power transmission when operating the unit as a motor. In

Figure 3 — Typical performance curves for rotary piston hydraulic unit.



addition, free flow of the oil through the flow passages, with no directional changes, produces practically pulsationless fluid delivery and quiet operation. For this reason, a large number of these units applied as pumps are used on domestic hydraulic elevator installations. In addition, fluid force is applied tangentially to the shaft through the piston tip resulting in the maximum transition to output torque for each unit of pressure. The low moment of inertia of the rotating elements allows instant reversibility with rapid acceleration and deceleration. Operating pressures to 3000 psi are obtainable with this design.

The sectional design Figure 4 makes multiple motor operation possible at independent pressures and speeds from a single pump and prime mover. The selector valve Figure 5, applicable to either pump or motor, controls flow and makes possible torque amplification without overload of prime mover. The transmission therefore can be precisely controlled either directly manually, or remotely automatically through positioning of this valve.

Table III from the aforementioned survey indicates how these various designs are applied. It is interesting to note that the types, other than gear, vane or piston design have a small percentage of the transmission applications and that transmission applications for all units are low compared to the pump output horsepower for cylinder application.

Again it should be repeated that only recently hydraulic units have been designed specifically for transmission applications and there is a continuing growth of installations in all industries, particularly those industries requiring variable speed transmissions in the higher horsepower ranges. Previously, here there only were available hydraulic units either too small or too delicate for the rugged continuous duty

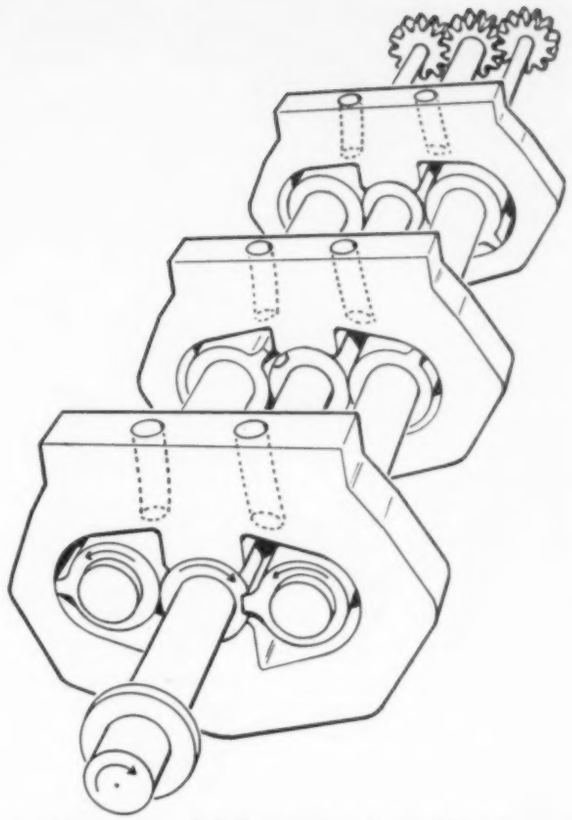


Figure 4 — Sectional design makes it possible to operate multiple motors at independent pressures and speeds from a single pump and prime mover.

that was usually required. One of these industries is the oil and gas industry which in the past six years has used an increasing number of hydraulic transmissions in drilling, production and transmission. Savings well

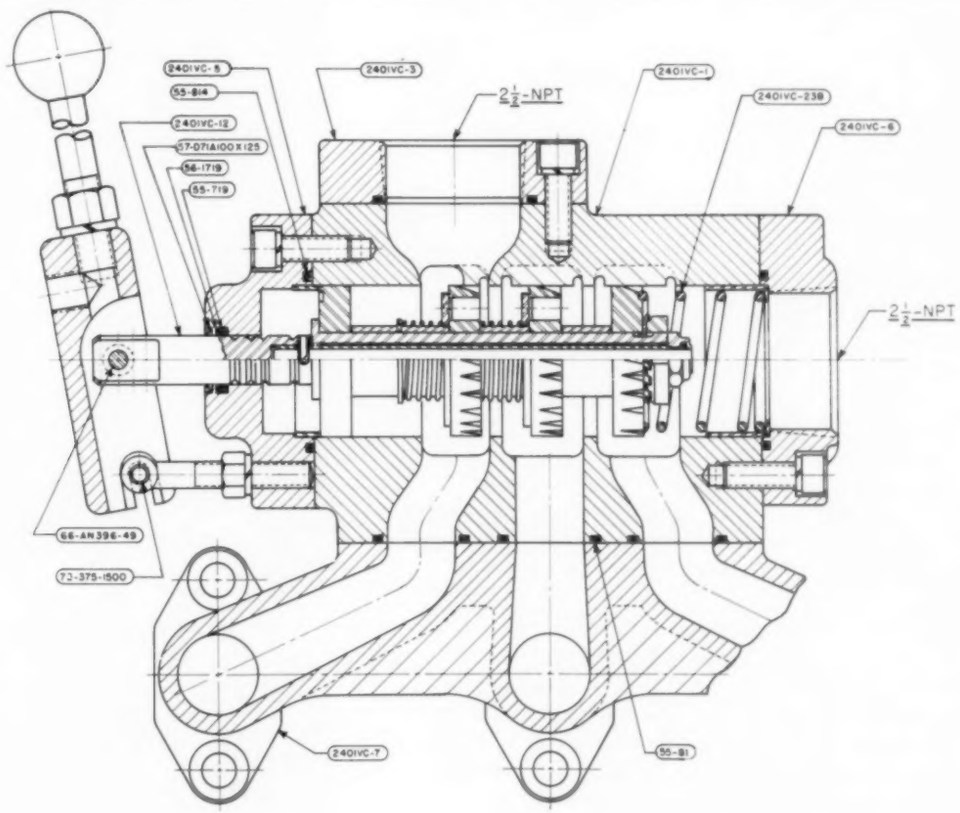


Figure 5 — Selective valve controls flow and enables torque amplification.

TABLE III
Usage by Type of Pump

Type of pump	Cylinder Application, hp	Transmission application, hp
Gear	3,450,928	14,650
Vane	750,789	47,665
Piston	...	32,570
Other	157,761	8,174
Total	4,359,478	103,059

over $15,000 per year per station are reported in the conversion of large gas compressor stations to hydraulics. In this instance, the large cooling fans for engine jacket water and other related components are powered by a pump, direct or V-belt driven, from the compressor flywheel.

Figure 6 shows a schematic diagram of a single cooling fan installation.

Figure 7 shows a large cooling fan mounted directly on the shaft of the hydraulic motor. Speed range here is from zero to 300 rpm maximum with automatic control of jacket water temperature, through regulation of fan speed. Figure 8 is another method of fan mounting with hydraulic motor.

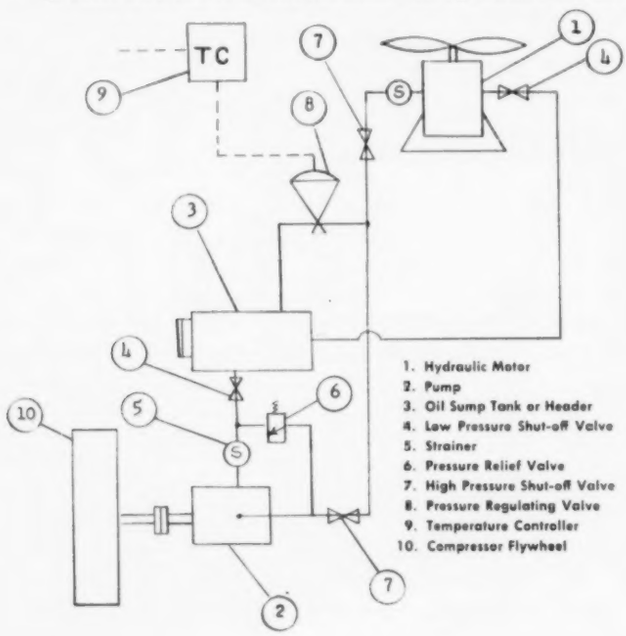
Figure 9 shows the precision of the temperature control of medium being cooled, obtained with variable fan speed.

Figure 10 shows the horsepower comparison between constant speed and variable speed drives and the resulting savings in horsepower which approximates 50 per cent of horsepower required for the constant speed fan.

An oil field application is the "drilling sub" shown in Figure 11. This unit consists of four hydraulic motors which power the pipe direct through a ring gear mounted to a short drill sub. The power oil for the drilling unit is supplied by a portable pump package shown in Figure 12. As the pipe is powered direct there is no need for the square "kelly" joint and rotary table which is used in conventional drilling. In addition continuous coring is possible without ever lifting the bit from the bottom of the hole which is of considerable advantage. The pump in this case is powered by a 125-hp, 1200-rpm gas engine.

The drilling sub produces 80 hp at 150 rpm of the

Figure 6 — Pump is either direct or belt-driven from compressor and fan is direct mounted on hydraulic motor.



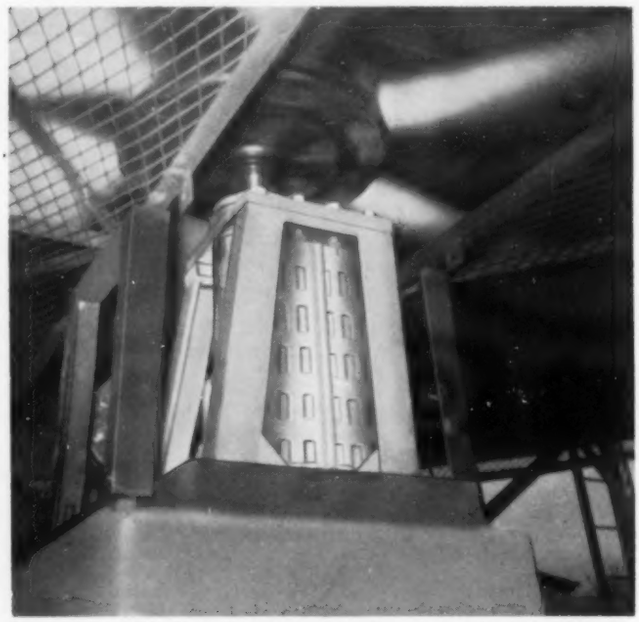
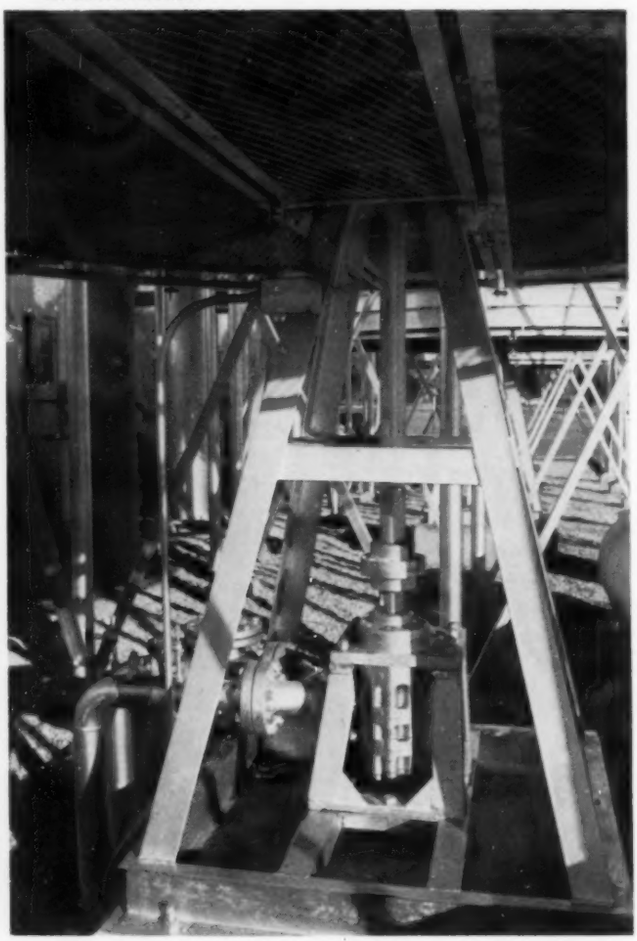


Figure 7 — Fan is mounted directly on shaft of hydraulic motor.

Figure 8 — Another method of mounting fan with hydraulic motor.



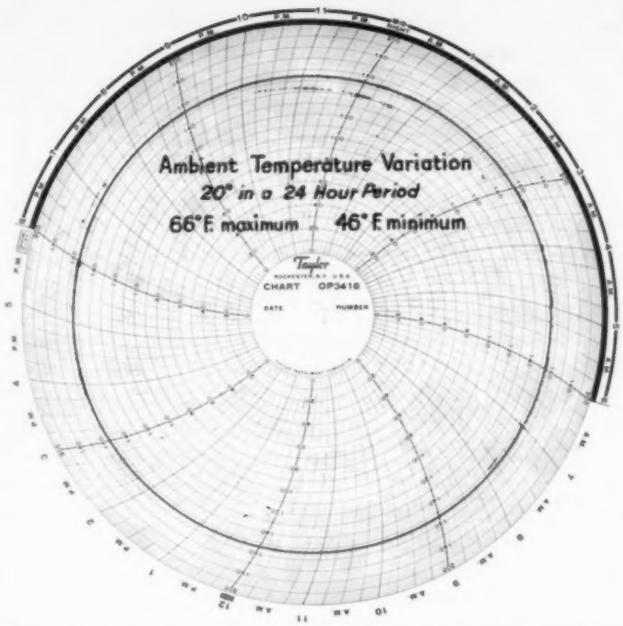


Figure 9 — Temperature control with variable speed fan is very precise despite a 20 degree ambient temperature variation.

pipe. Maximum stall torque on the drill pipe is 4300 lb-ft. Over 100 wells in Canada have been cored with this method.

Components on the drilling rigs such as shale shakers, blow out preventers, and water pumps are also operated hydraulically. Here the multiple motor system from one pump is applied. In the lumber industry both sawmills and lathes are using hydraulic transmissions. Carriages weighing with logs 18,000 lb are being cycled at the rate of 20 times per min with a 20-ft stroke. The application of hydraulic transmissions to veneer

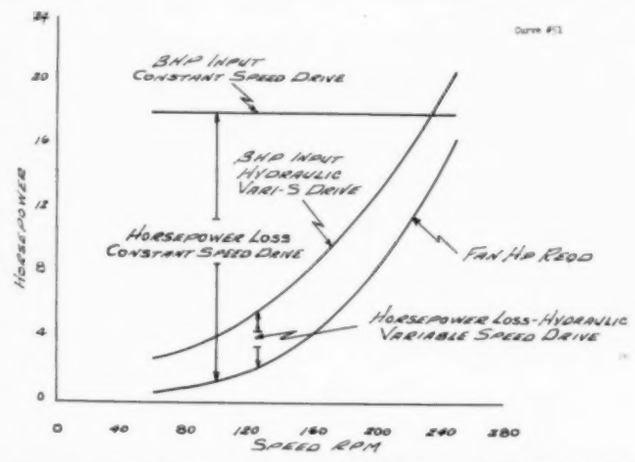


Figure 10 — Curve compares horsepower obtained from constant speed and variable speed drives.

lathes has increased production 30 per cent. Horsepower ranges on these applications are between 50 and 275.

In the industries mentioned, continuous duty, 24 hr per day with trouble free operation, is of prime importance in selecting transmission equipment—particularly in the oil industry where shutdowns are extremely costly. However, in the past six years, hydraulic transmissions have proved completely satisfactory on these rugged services.

Figure 11 — Hydraulic motors power the pipe directly through a ring gear.

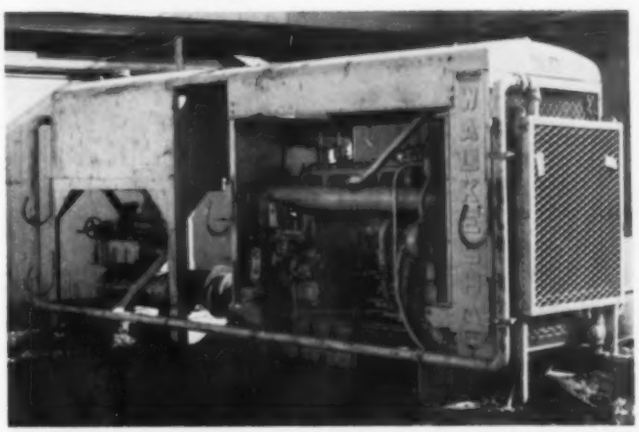


Figure 12 — Portable pump supplies power oil for drill unit.

There is every reason to believe that equally satisfactory service can be expected from hydraulic transmission in steelmaking.

An extremely unique hydraulic installation is a continuous casting mill for iron pipe. All mechanical movements of the casting machines and their component parts with the exception of the spinning of the mold are hydraulically powered.

These machines are used for centrifugally casting 2 and 2¼-in. inside diameter pressure pipe in 20-ft lengths for water and gas service. The pipe is cast in a rapidly revolving water-cooled steel mold mounted in a car or box set on an inclined track on a 6 per cent grade.

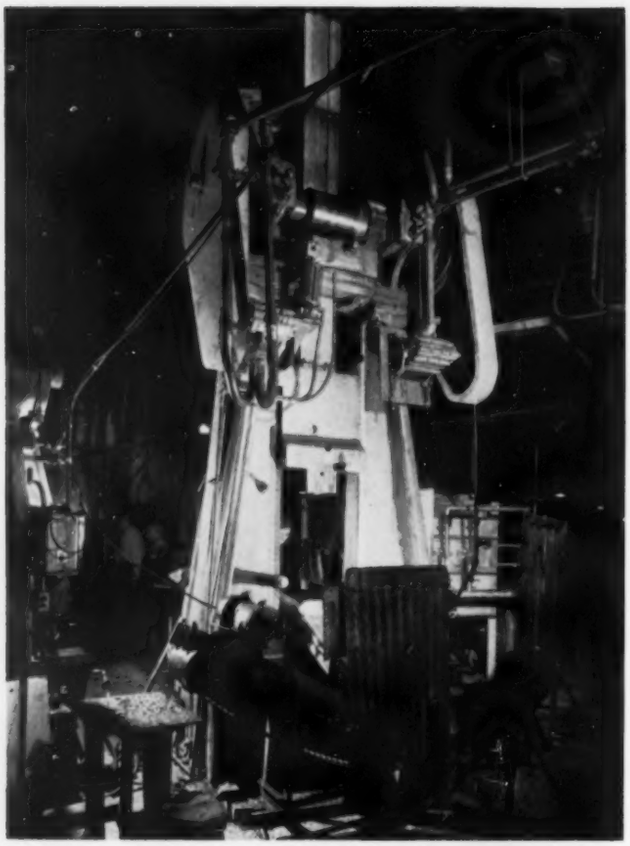
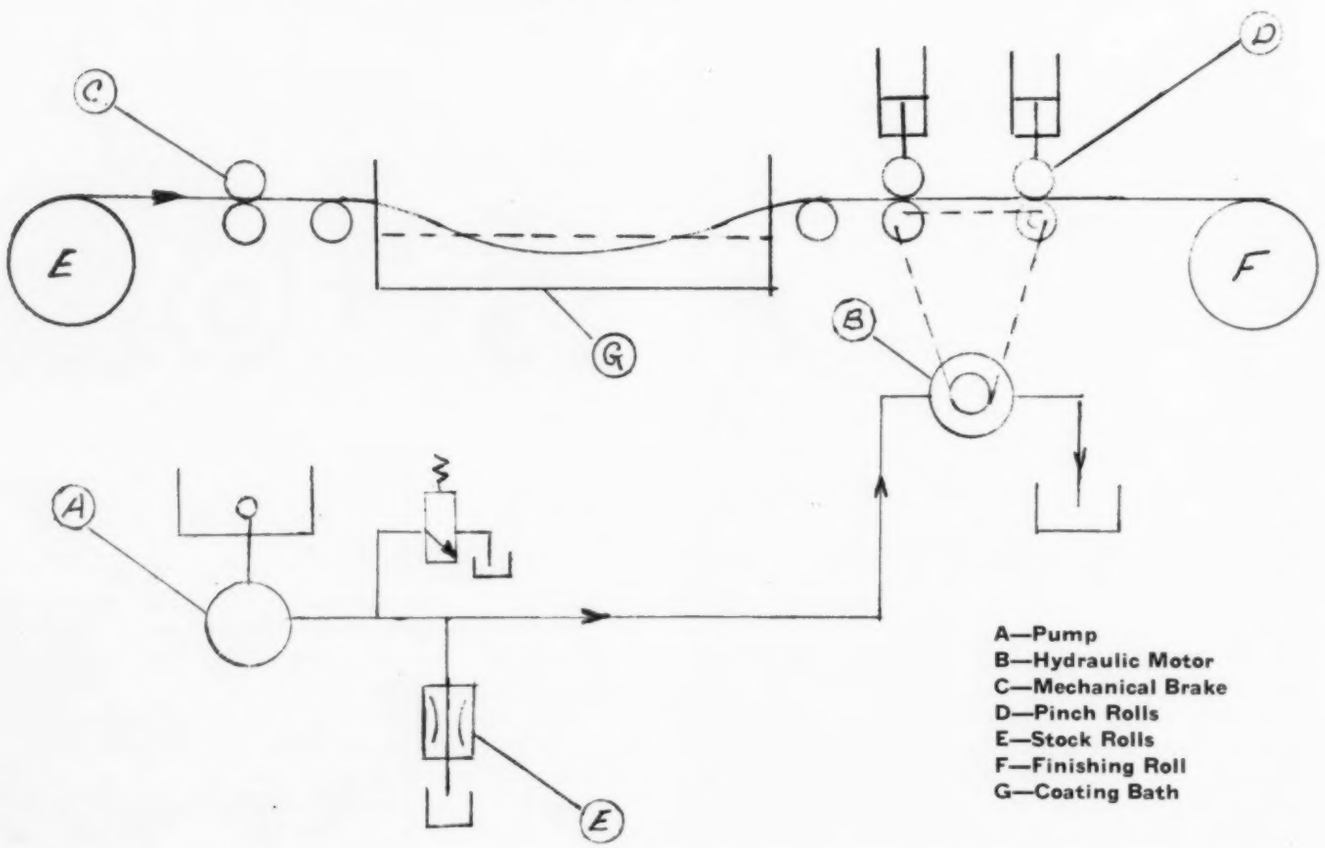


Figure 13 — Drop hammer drive uses hydraulic power transmission.

The mold box complete weighs approximately 25,000 lb and has a longitudinal movement of about 25 ft. The casting operation is started with the mold box in the "up hill" position. A long fixed metal trough protruding into the mold delivers molten iron to the lower end first and then throughout the lengths of the mold as the mold car is moved down hill at a uniform rate of speed. Due to the centrifugal action of the rapidly revolving mold, the iron forms in a cylindrical shape on the inside of the mold and the pipe is thus made. As soon as the iron in the mold has solidified, the revolving mold is stopped and the pipe extracted by means of a hydraulic pulling mechanism.

It is obvious that in order to produce this small diameter long length pipe with a uniform wall thickness, accurate control of mold car speed and rate of pouring of the iron must be obtained. These factors together with other considerations involving acceleration and deceleration of the mold car, ease of adjustment, maintenance, etc., led to the selection of an oil-hydraulic system. The longitudinal movement of the mold car is accomplished by means of a cable drive employing a fluid motor direct-connected to a speed reducer carrying drum for the cable. Fluid power is supplied by a pump driven by a 25-hp electric motor. Control valves are oil pilot operated by means of solenoid pilot valves. The pipe extractor mechanism is also cable driven, and is operated by a separate hydraulic system consisting of a pump and motor. Hydraulic units are also used in a third system to operate the pouring ladle. Pipe production on a continuous basis is extremely high. The hydraulic system has performed

Figure 14 — Schematic shows simple circuit for the winding roll in a plate coating operation.



to the complete satisfaction of the operators.

Another transmission application in operation is the drop hammer drive shown in Figure 13. Here the rolls are driven by fluid motors and are operated continuously. This hydrostatic hydraulic drive system has been in service since June, 1951 for 16 hr a day, operating the 2000-lb hammer. The results—longer board life, less downtime, more production and lower maintenance—have been better than predicted. The differential in initial cost has been more than absorbed by these savings. The hydraulic oil operating the fluid motors creates a cushion at the moment of gripping the board, thereby reducing wear and assuring longer board life. Life of the hardened maple boards has been increased 400 to 600 per cent.

Several 17½- and 25-ton mobile yard cranes have been converted from steam to diesel-hydraulic in recent months. Positive displacement hydraulic units were used for precision control of hoist, swing and travel. Production increase in crane operation has been noted, particularly with independent swing. Here again the sectional design of hydraulic units allows for operation of the "swing" motor from the main pump at the same time the load is being hoisted or lowered. Braking of the load with instant reversibility is an additional advantage obtainable with a hydrostatic system. Engine torque is multiplied 7 to 1 through the use of "selector" valves on both the pump and motor.

Several years ago, a draw bench was equipped with a hydraulic transmission with an increase in production. Through the use of multiple place pump and motor, the various operations could be controlled automatically with extreme flexibility. The motor places were series-parallelled which produced maximum speed of the chain on the return stroke, and maximum torque during the draw.

Figure 14 shows a fairly simple circuit on a winding roll in a plate coating operation. Here the speed of the hydraulic motor is controlled manually through operation of a hand operated by-pass valve. Tension on the plate and speed must be controlled to assure the desired coating.

The arm of the manipulator shown in Figure 15 used for handling hot ingots is also powered by a high torque hydraulic motor.

Here it is desired to hold ingot position during transfer which of course calls for maximum "stall" torque on the hydraulic motor.

These are a few of the transmission applications in the steel mills and other industries with similar transmission problems.

These same principles can be applied to larger and more complex machines. It is of course up to the hydraulic equipment manufacturers to produce units with the inherent characteristics and horsepower capacities required, as the design and operating engineers, realizing the advantages, increase their demand for hydraulic power transmissions.

Figure 15 — Hydraulic power on manipulator aids in visibility.

DISCUSSION

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A. E. LYNGSTAD, Electrical Superintendent, Colorado Fuel & Iron Corp., Buffalo, N. Y.

J. G. Mitchell: I will not go into very much detail on the applications that we have made at the Steel Company of Canada. We had two locomotive, steam-powered cranes. The steam power units were taken out and replaced with diesel engine and hydraulic pump and motor power transmission to the drives. The first machine converted has been in operation for two years now, has given very good performance and has been in the shop just recently for the periodic overhaul, and inspection. The equipment appears to be in fairly good shape. We have replaced a few bearings according to the recommendations of the manufacturer where the bearings lasted their expected life.

The second piece of equipment has only been in operation for a few weeks. We did actually encounter some difficulties in getting the equipment commissioned in the first place. I think this probably bears out the statements that have been made to the effect that some

of this equipment is still undergoing a certain amount of development where it is being used for the first time, but it appears that after the necessary adjustments have been made, we can expect fairly good performance.

I think too here some of us probably will say this equipment has not been properly field tested until it has been used in the steel industry for some time.

Jack C. Vierkorn: I have been asked to give a short description of the hydraulic equipment being used in the open hearth division of the Lackawanna plant of the Bethlehem Steel Co.

In January 1953, we acquired two 10-ton hydraulic chargers at No. 3 open hearth due to an expansion program at that time. These chargers had conventional electric motor driven bridge, trolley and peel rotate drives, the bridge used standard spur gears and the trolley and peel rotate used cone worm gears.

The hydraulic motions were the hoist and pan clamp.

The main reason for incorporating hydraulic operation on the chargers was to give better side and front vision to the car operators by the elimination of the hoist motor, crankshaft, and back peel hanger. However, after being put in service, other advantages became apparent.

The hydraulic system itself when assembled was a beautiful maze of pipes, valves and hoses. The only part familiar to us was the 50-hp shunt motor driving the pumps. Connected to one end of this motor was a 58-gpm pump which relieves back to the tank through a 2-way valve at about 900 psi. The pressure that this valve unloads is regulated by a sequence valve. Higher pressures than 900 psi on this pump overload the motor. From 900 up to 1100 psi to 1375 psi, our regular operation pressure, an 18-gpm pump takes over from the other end of the motor.

Besides the 2-way valve and sequence valve, there were two 4-way valves, each different, pilot valves, pilot pressure reducing valves, a foot valve, a final pressure relief valve, two check valves, orifice check valves, even an orifice coupling, 1-gal accumulators, two needle valves, and two pressure gages, both connected to the same main line. This had us puzzled for a while until we figured that one of the gages must belong to the pilot pressure line. After changing that over, we got along a little better.

By the time we could pinpoint trouble easily and quickly, we installed a new single pump system. This pump is a 67-gpm variable delivery pump with internal discharge and pilot pressure furnished by an integral gear pump.

Installation of this pump, about six months ago eliminated about one-half of our valves and we have had no trouble since.

The hoist is operated by two 5½-in. pistons with a 20-in. stroke cushioned 3 in. from each end by needle valves. They are mounted at the back end of the peel extending into the cab, one on each side.

The peel clamping piston, 10 in. diameter with 9¼-in. stroke, is mounted on the side of the peel and is connected through a lever arm to a 4-in. lock rod which is connected to a square forging with a flanged head which fits into the charging pan. By operating the piston, you could pull the pan against the end of the charging bar and clamp it rigidly with no wobble or no dangle.

As usual with any new equipment, we had operator resistance. They said all of the motions were too slow, they could not see the peel head to get it in the pan, why did we not buy chargers similar to the old ones as they could charge a furnace twice as fast with them.

However, after running the new charger about a week, they found that they were charging faster than the old chargers. They have even admitted that they can run the hydraulic charger 16 hr and not be as tired, as after running the old 7½-ton charger for 8 hr. This is probably due, as Mr. Taylor explained, to the hydraulic absorbing most of the shock that is usually transmitted back to the operator. The stiffness of connection between pan and peel also eliminates shock when rotating peel.

All in all, these chargers are doing a very good job.

In conclusion, I would like to ask Mr. Taylor one question. What would the effect be of operating the hoist with two pistons of different diameter, say one 5½ and the other 5¾ in.?

Charles R. Taylor: While I am not familiar with the machine, I believe you could synchronize the pistons with a flow divider assuming the relief valve on the pump is set for the operating pressure required on the heaviest loaded piston.

We have a comparable installation on a loading platform where the loads are unbalanced, but the piston diameter on two cylinders operating the platform is the same. The flow divider synchronizes the movement of the two pistons regardless of the uneven loading. I would therefore assume the results would be the same on two pistons of unequal diameter providing the flow is balanced proportionately to the piston requirements.

R. B. Cornell: Mr. Taylor's description of rotary hydraulic power has been most interesting and indicates that a constant speed prime mover can be given characteristics quite similar to a variable voltage electric drive through the medium of oil hydraulics. This should interest the steel industry, especially since it is claimed that the control is simpler and the space requirements are less. Differences in the control features obtainable for these two types of drives, no doubt, prove that each has a best field of application. The derrick at Stelco that uses a hydraulic drive, is perhaps a place where a variable voltage drive would not fit in quite so well, although both would do about the same job.

The saw mill drive impressed me. The control station was simple, the hydraulic motor was surprisingly small, and the smooth rapid reversals would be a credit to any drive.

I would appreciate an opportunity to learn more of the principles involved in the control of such hydraulic drives. At Dofasco we do not have an application of this type but we are very receptive to better and cheaper ways of doing things.

L. C. Williams: What maximum horsepower has been developed in pumps or motors?

Charles R. Taylor: There are a number of pumps on the market for 100 hp. These same units installed as motors can produce 300 hp at the higher motor speeds. We have built and tested up to a 1000-hp unit for a diesel-hydraulic locomotive drive. Some manufacturers are now producing units up to 4000 hp.

J. G. Mitchell: I was wondering if Mr. Taylor could make a brief explanation as to why some types of hydraulic motors retain the maximum torque efficiency at

a lower speed whereas apparently other types lose their torque efficiency when you get down to the very low speeds?

Charles R. Taylor: The extent of the mechanical efficiency at low speeds is based on the construction of the units. Where units are designed with actual metal to metal contact or rubbing surfaces, the mechanical losses of such a unit increase proportionally with a decrease in speed. They therefore become a larger percentage of the torque or mechanical efficiency as speed is reduced. Where units are designed with no contacting surfaces and with all rotating parts operating on antifriction bearings, their mechanical efficiency or torque remains high at slow speeds.

A. E. Lyngstad: Do you find any problems with the heating of the hydraulic oil when operating on a 24-hr, 7-day week operation? If so, what type of heat exchanger do you use?

Charles R. Taylor: The amount of heating of the hydraulic oil is dependent on the type of application involved. On the fan drive applications that were shown, the fan horsepower is proportional to the cube of the speed, therefore when using constant displacement pumps with speed control on a by-pass system, the oil not required for motor speed is being by-passed at a reduced pressure. In addition there is sufficient piping in these systems to dissipate any heat build-up and an acceptable oil operating temperature results, therefore no coolers are required. This same horsepower characteristic applies to some types of agitators in chemical plants and marine drives. Heat exchangers are required usually on constant torque, variable speed applications or where braking is being done by the hydraulic system as the carriage drive in a sawmill. On constant torque applications, maximum torque or pressure is required at minimum speed or reduced oil flow. It is therefore necessary to by-pass, on positive displacement units, the oil not required at the maximum pressure. This of course results in considerable heat build-up which must be dissipated through some type of heat exchanger.

The drilling sub, for example, requires maximum torque at very slow speeds, also the crane, when hoisting, requires the minimum amount of oil for speed control, but the maximum pressure for raising or lowering the load. It was therefore necessary to install the "selector valve" on the pump to regulate pump delivery in proportion to the speed of the hydraulic motor. Under this system, with a multi-place pump, the oil not required is being returned to the tank at atmospheric pressure, while the "place" in operation is furnishing a reduced amount of oil to the motor at maximum pressure required. With such a system, the minimum amount of horsepower is converted to heat. It is easily realized that on 125 to 150-hp installations, such as are encountered on cranes, a straight by-pass system with conventional positive displacement pumps is not practical.

With regard to coolers, both shell and tube and radiator type, with and without power driven fans have been employed.

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. . . . experience with power distribution at the Fairless plant indicates that the equipment has been excellently designed and engineered, and that the operational methods which have been set up are sound . . . .

Operation of the Power System at Fairless Works

By

George A. Goetz,

General Foreman Electrical Operations

Fairless Works

United States Steel Corp.

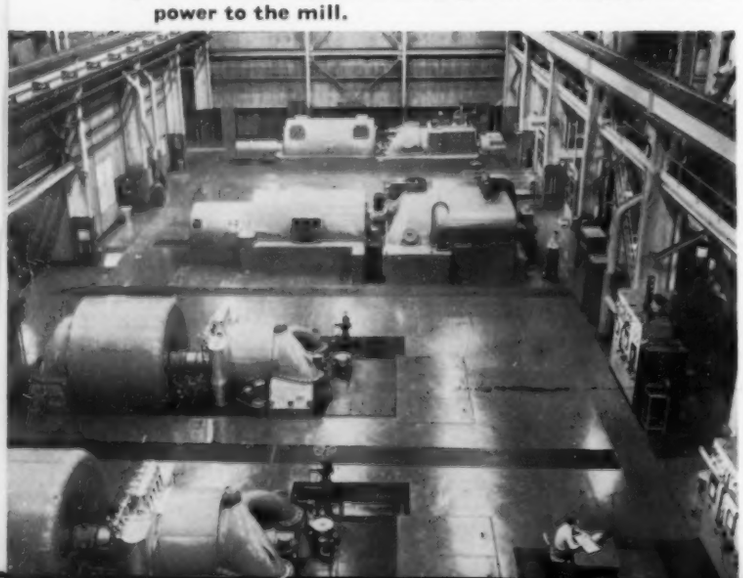
Fairless Hills, Pa.

▲ THIS paper will describe the equipment used in the Fairless Works, United States Steel Corp., power system and its operation, in parallel with the public utility, to assure the most economical use of purchased and generated power consistent with steel mill operating practices.

Electrical power is supplied to the mill by the two 30,000-kw turbogenerators shown in the background of Figure 1 operating in parallel with the public utility company. These two machines operate from 850-psi, 900 F steam, are hydrogen-cooled and generate at nominally 13,800 volts. They are located at the main powerhouse with the turboblowers shown in the same figure and are connected through two 20/25/33.3 OA/FOA/FOA/mva (oil-to-air)/(forced oil-to-air)/-(forced oil-to-air) million volt-ampere transformers to the primary, 69,000-volt, plant distribution system. Those operating departments located geographically close to the powerhouse receive their power through duplicate underground cable feeders from the powerhouse buses at 13,800 volts. The balance, which represent the bulk of the mill operations, are fed from the primary power system.

This system, shown in Figure 2, consists of twin 350,-000 circular mil copper transmission lines of 35 towers extending a distance of approximately seven miles and supplying three primary substations. Two of these stations have 20/25/33.3-mva transformers similar to those at the powerhouse from which radial underground feeders supply mill load at 13,800 volts. The other has two 3750/4637 OA/FA (oil-to-air/forced-air) kva 69/-2.4-kv transformers which supply power for river water pumping at 2400 volts. The entire system connects to the utility company through two 30/37.5/50 OA/-FOA/FOA-mva transformers at 132,000 volts in the substation shown in Figure 3.

Figure 1 — Two 30,000-kw turbogenerators supply electric power to the mill.



The over-all operation is controlled from the powerhouse dispatching office shown in Figure 4 which is equipped with necessary metering shown in Figure 5 to supply the dispatcher with information regarding real and reactive power usage that will allow him to operate in accordance with contract regulations.

This control room contains, in addition to this power distribution metering, operating controls for the two generators and the feeders supplied directly from the powerhouse at 13,800 volts as well as supervisory controls for operation of circuit breakers on the primary power system and for changing taps at the transformers which connect the system to the utility company.

The two generators and any large motors (over 1000 hp) are protected by differential relays "backed up" with overcurrent relays that involve a voltage characteristic or by voltage relays alone and by ground overcurrent relays. Transformers are similarly protected by differential relays "backed up" with overcurrent and ground relays and in the case of the large primary substation transformers with "inrush suppressors" to avoid false tripping in energizing the transformer. Station buses are protected by differential relays or overcurrent

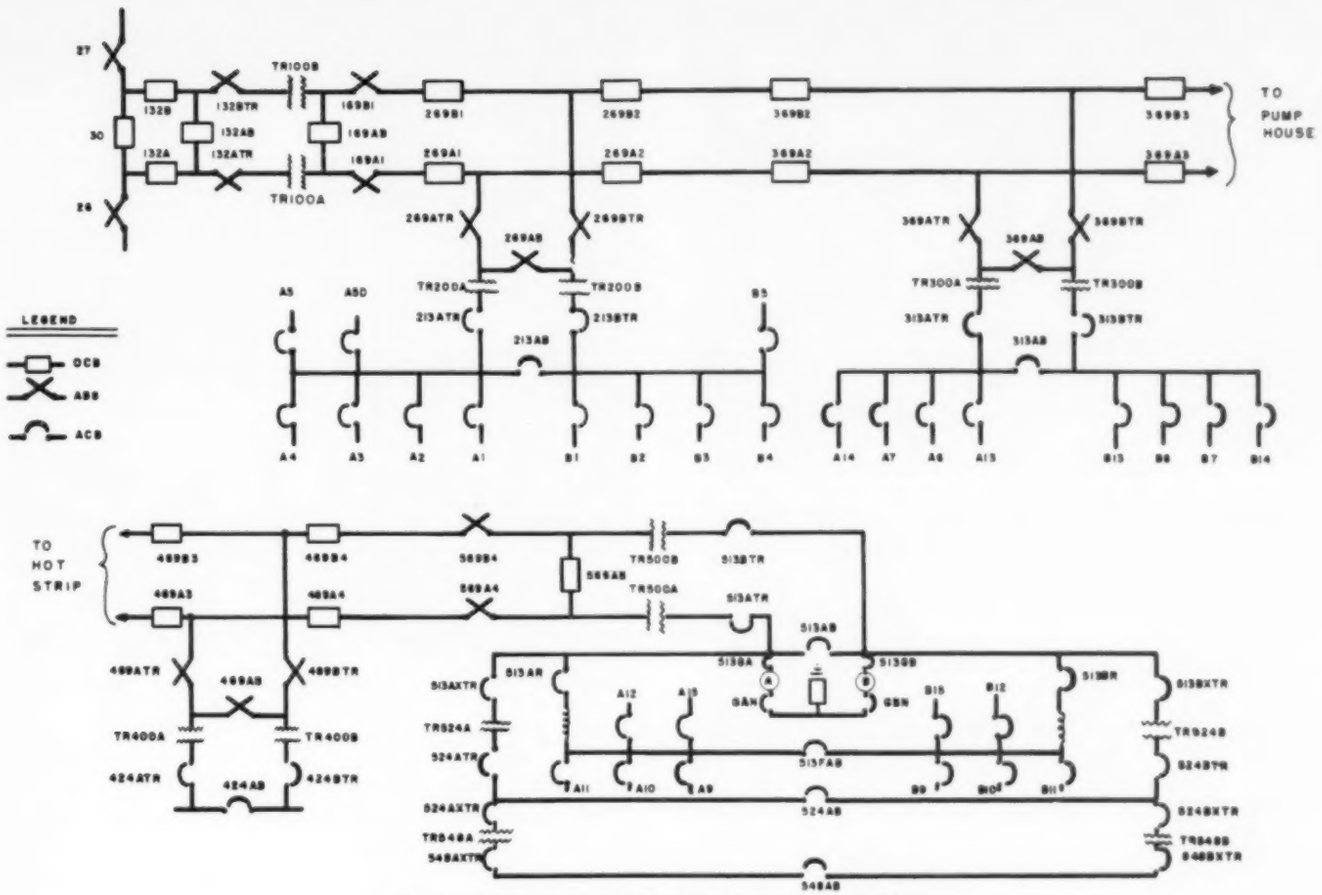


Figure 2 — Layout of electric distribution system.

relays connected differentially with similar overcurrent "backing up."

Transmission lines and cable feeders are protected by pilot wire relays "backed up" by overcurrent and ground relays. In the case of transmission lines, these "back up" overcurrent relays have directional properties which allow them to "look into" the line section protected by the pilot wire relay. The pilot wires themselves are "supervised" by relays which circulate a direct current and sound an alarm on loss of a pair of wires either by short circuit, open circuit, or ground. In some cases these relays and wires are used for "transfer tripping". (That is to operate breakers at both ends of a line simultaneously.)

Switching of load or fault currents is done through circuit breakers. On the primary (i.e. 69-kv) system, oil circuit breakers are used and each is equipped with a gang operated manual air break switch to provide a positive, visible, break in the circuit when maintenance work is required, and also a "test" position for trial operation after completion of maintenance or for some phases of maintenance such as timer tests, etc., which require observed operation.

On the secondary circuits (i.e. 13.8-kv and below) air circuit breakers of the drawout type are used. The drawout characteristic of these breakers provides the positive break required for safety reasons and also the test position for observation during maintenance work. An exception to this is found on the generator bus breakers which are air-circuit breakers, but quench the arc during current interruption by a "blast" of air. For this reason they are not of the drawout type, but are provided with disconnect switches to create a "test" position. These switches are "interlocked" so that unless they are in test position, operation from "test" push buttons in the breaker mechanism is not possible.

Motor operated air break switches are used to magnetize transformers and here serve the dual purpose of supplying a positive, visible break and also switching

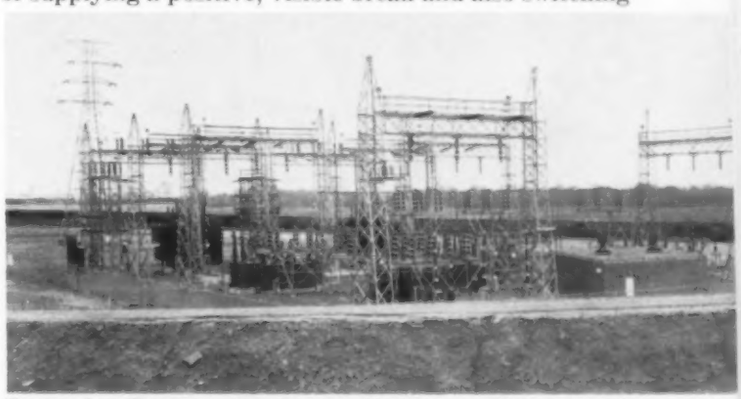


Figure 3 — Power system connects to the utility through transformers at 132,000 volts.

Figure 4 — Overall operation is controlled from this powerhouse dispatching office.

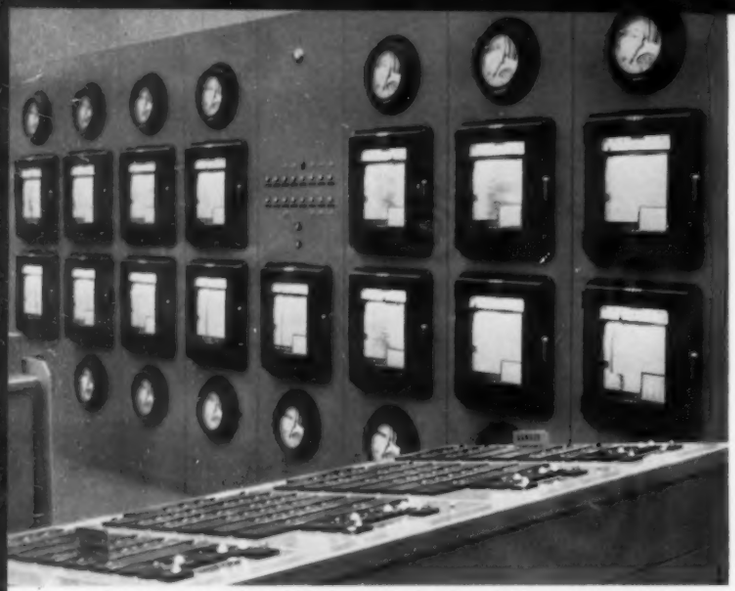


Figure 5 — Elaborate metering furnishes dispatcher with data needed for operations.

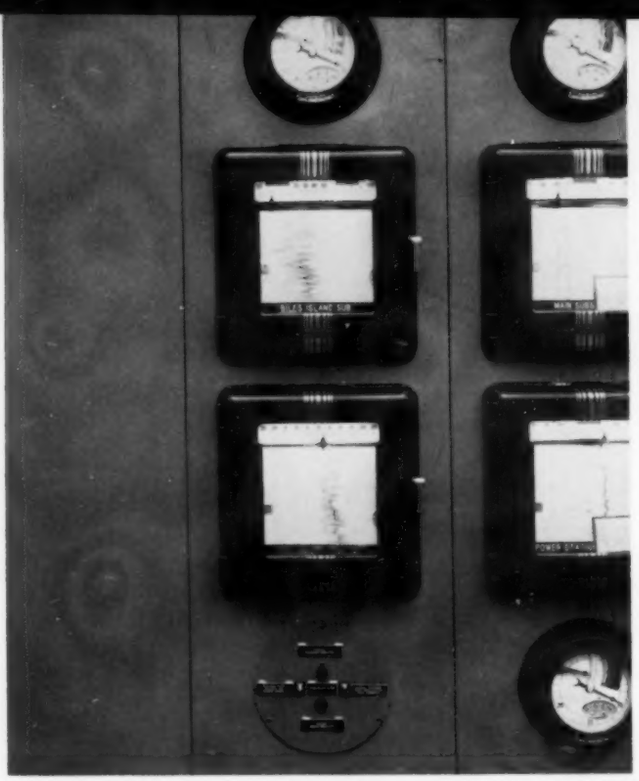


Figure 6 — Meters give information on actual purchased power.

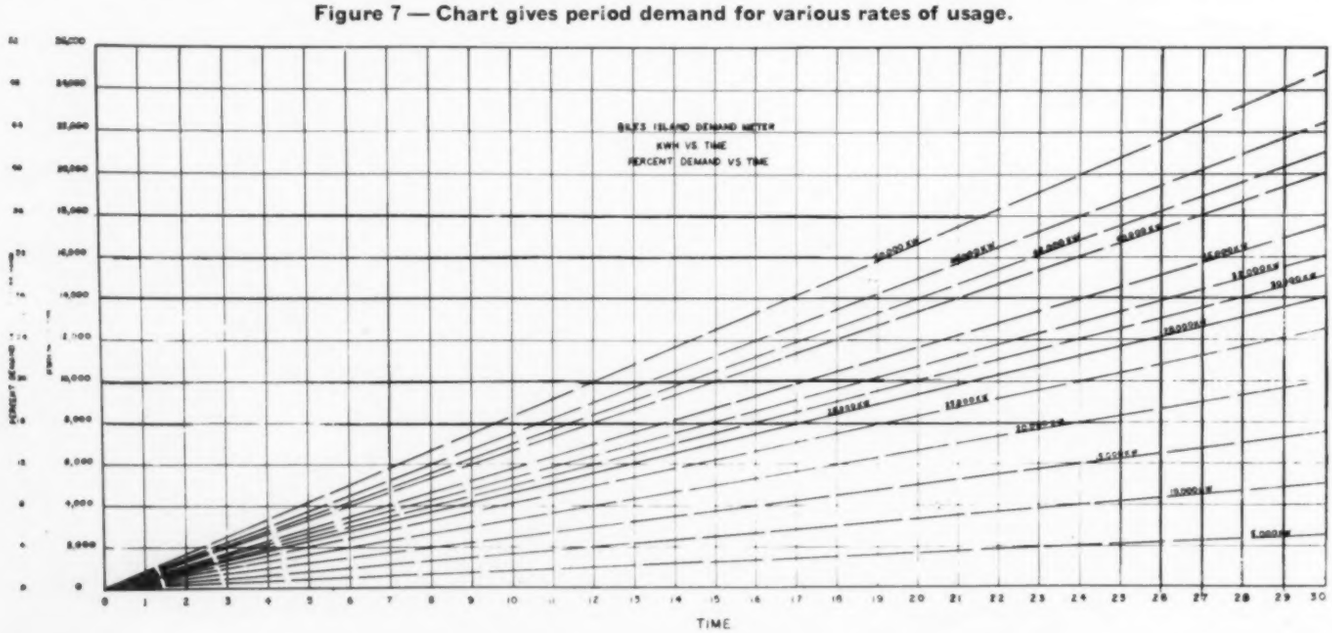
small currents. These disconnects are controlled from the powerhouse supervisory desk and are intricately interlocked to transformer secondary breakers so that they cannot be operated unless the transformer is fully unloaded.

Each primary substation is provided with a "tie" air break switch to permit using either transformer from either transmission line. These switches too, are interlocked to transformer secondary breakers to preclude a possibility of interrupting large currents. The auxiliary switches of all these air-break switches in each station are used to transfer transformer differential relaying tripping circuits so that when operating with a tie air-break switch closed, the proper transmission line oil-circuit breakers will operate to clear a fault in either or both transformers.

The cost of electrical power purchased from the utility company contains demand, energy and fuel adjustment charges, as well as limitations on reactive power in the form of a minimum power factor requirement. The energy and fuel adjustment charge amounts to approximately 60 per cent of the total and can be controlled by using available generation rather than purchasing energy from the electric company. Since it is based on rather large units of energy, considerable time such as one or more complete turns are required to affect it appreciably.

The demand charge comes to approximately 40 per cent of the total. Because it represents such a large percentage of the total bill and number of dollars, it is advantageous to keep it to the lowest value allowed by the contract. It is based on the average power usage over a specified short period of time. This charge can be materially affected by controlling the mill operation within any particular demand period. For this reason relatively short mill delays (10 to 15 min) can save appreciable amounts in the power bill.

Figure 7 — Chart gives period demand for various rates of usage.



Obviously, however, too frequent short delays will amount to total delays for the month which cost more than the savings realized in the power bill. Thus, when the operations are planned in such a manner that further control by delaying mills is not required, the end result of a minimum power bill will be achieved.

The actual purchased power is telemetered from the point of interconnection to the dispatching board shown in the Figure 5. This information is received on the instrument shown in Figure 6. It is equipped with a register for kilowatt hours from which the operator, by the use of a graph shown in Figure 7, or a calculating "wheel" illustrated in Figure 8, can determine what the period demand will be at that rate of usage.

This panel also contains a demand meter shown directly above the power recording meter that will sound an alarm if this demand is approaching either a contract limit or a previously determined desired maximum. The dispatcher will then signal individual mills to curtail operation by toggle switches shown in the center of the panel in Figure 5 that are mounted on the dispatching board which sound a gong and light a flashing light at the mill. One of these alarm signals is shown in Figure 9.

A typical purchased power chart which shows the effect of these delays to control demand is shown in Figure 10. The line AA represents what the demand would have been for this period if mill curtailment had not been put into effect. The line BB represents the actual demand after delays were effected, and the line CC, the actual or desired demand. The period DD represents the actual time that mill delays were required before the demand period in question ended and a new period which would average the energy comsumption for demand purposes from a new starting point began.

The kind of product and the size of each mill will affect its power consumption so that the amount of correction that is obtainable will vary from mill to mill. Since the control room personnel will not be familiar with the urgency of any particular product, the order in which mills are to be delayed is established by the production planning department and given to the control room once each week for the following week.

The power usage (demand) of each mill is influenced by the type and amount of products which it rolls. For this reason, graphs like those in Figure 11 were developed for each mill, to be used in conjunction with mill scheduling and reduce the possibility of expensive delays. Their use involves estimation of how much will be produced in a half hour period by the mill. If this estimate is made on the basis of a minimum of mill delays from other causes such as cobbles, breakdowns, etc., the estimated figure will be high so that all predicted delays will not occur. If, however, the schedule is arranged so that no delays are predicted, then it would be virtually impossible to have them, although if the schedule does not recognize products to be rolled, it is

Figure 9 — Meters sound alarms when demand approaches any previously determined maximum.

Figure 8 — Calculating wheel can also be used for determining period demands.

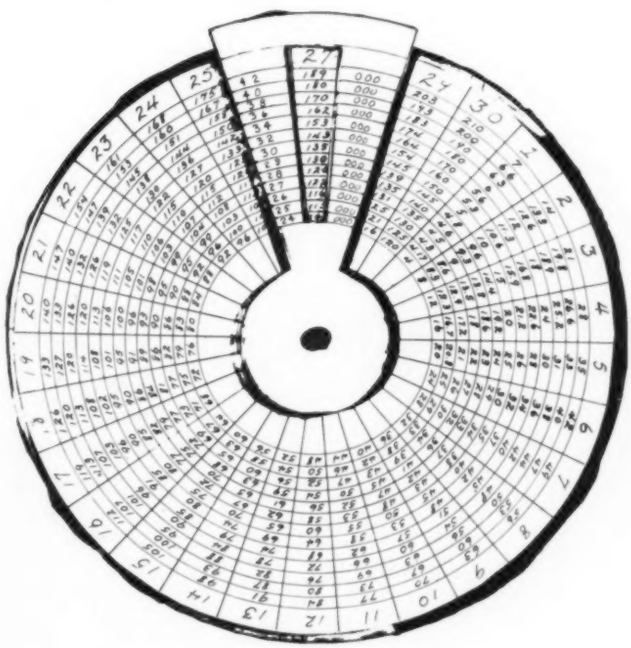
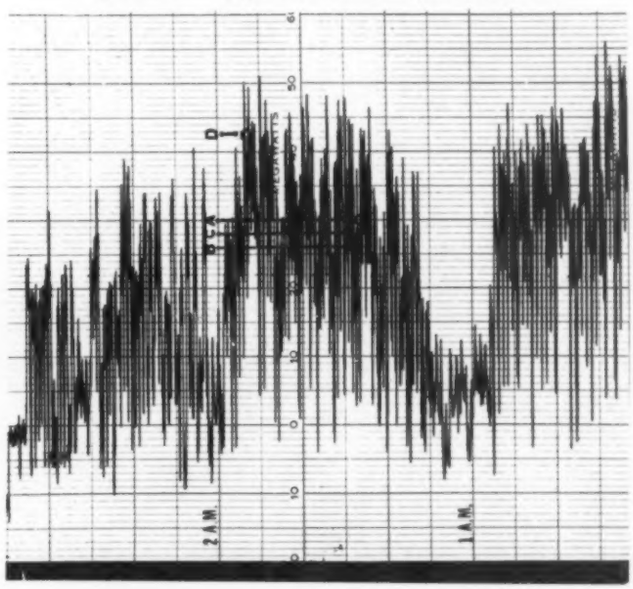


Figure 10 — Typical purchased power chart.



possible that with identical mills, rolling delays may result in one turn or part of a turn but not another.

This fact has been demonstrated on several occasions recently when, with essentially the same mills operating, delays were required in one period but not another. In order to avoid this circumstance, the utilities department has in its organization a person designated, co-ordinator utilities dispatching, whose duties include meeting with the production planning department and participating in weekly mill scheduling meetings. Unfortunately, mill operating problems such as emergencies which have caused breakdowns that necessitate repair turns, or the availability of other utilities, prevent the establishment of a perfect schedule from an electrical demand standpoint. This co-ordinator, however, will be familiar with all the utilities availability problems, and by participating in the scheduling discussion, can obtain the most desirable operating schedule from a departmental standpoint, even though it may at times necessitate higher than ideally normal electrical demand.

These graphs have been put to use to supply engineering or operating data of a predictive nature by plotting a family of curves from them for different amounts of production as shown in Figure 12. If the logarithms of the value shown by these curves are plotted, a straight line will result. Plotting of the slopes and intercepts of these lines as a function of production will create other straight line graphs from which an equation of the form $D = A^{(fW)}$ (fW) where D represents demand, A area, and W the amount of production in the demand period can be written to express the probable demand for production of any given area material.

Reactive power flow is received on the instrument mounted directly below the real power instrument in Figure 6. With a known value of real power the dispatcher can calculate from the limiting values of power factor the permissible reactive power flow. If the reactive power flow in either direction is exceeding desired limits, it is adjusted either by varying the voltage at the generator bus or by changing taps at the interconnection transformers shown in Figure 13.

A section of this reactive power chart is shown in Figure 14. It will be noted from this chart that operators attempt to average zero reactive flow which will present a unity power factor to the utility company. The effect of one tap change at the interconnection is shown by the line GG.

By making these changes in the latter manner, the bus voltage of the powerhouse can be held at a relatively stable value. This is important since some load is supplied directly from this bus which will feel voltage drops more seriously than those occurring on the 69,000-volt transmission system. These taps are 2½ per cent each and the operating mechanism which is controlled from the supervisory desk is shown in Figure 15. The transfer contacts operate in oil and are housed in the compartment seen directly above the operating mechanism in Figure 15.

As in any operation, there have been occasional equipment and personnel failures resulting in abnormal power purchases and interruptions of power to consumers. When such an emergency occurs, the exact procedure for correction and restoration of power to affected areas varies with each situation. Individual operators who are entrusted with the responsibility of maintaining a continuous power supply to all consumers are expected to analyze each particular situation as it develops and take necessary corrective action. This dependence on operators for detailed solutions in emergencies is desirable, not only because of the awareness of responsibility which it inculcates in the personnel, but also from the standpoint of the many variations which emergency situations can take that make it virtually impossible to conceive and develop solutions beforehand.

There are, however, several precautionary measures taken in everyday operation which are intended to minimize the effect of an unexpected emergency, and the operators are given several general principles to be observed in working out of an outage situation.

One of these routine precautionary measures involves the continuous operation of one of two 24,000-gpm steam-driven pumps at the powerhouse at slightly below line pressure so that in the event of a loss of pumping facilities at the river pumping station, a source of service water for urgently needed blast furnace and open hearth cooling will exist. Although one such pump will not supply the total water requirements at the mill, it will minimize the effects of an interruption and will supply the cooling water which is necessary to avoid

Figure 11 — Chart gives blooming and billet mill kw demand for various areas.

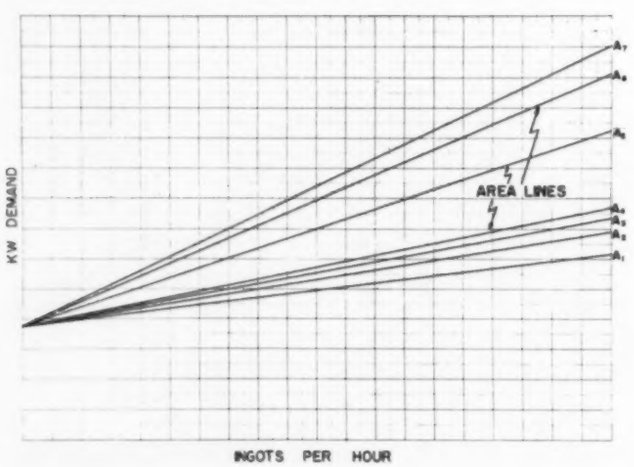
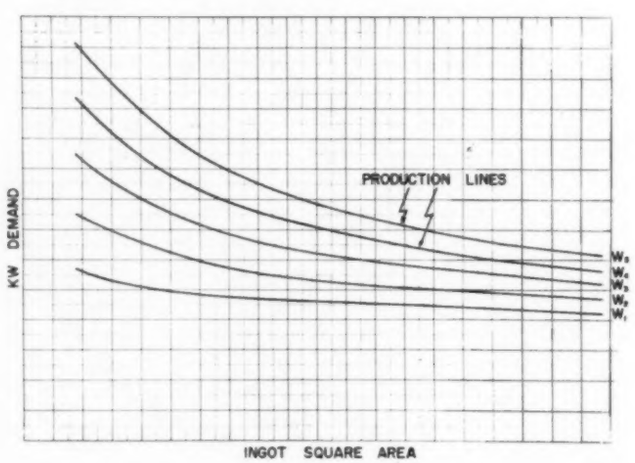


Figure 12 — Chart gives blooming and billet mill kw demand for various areas.



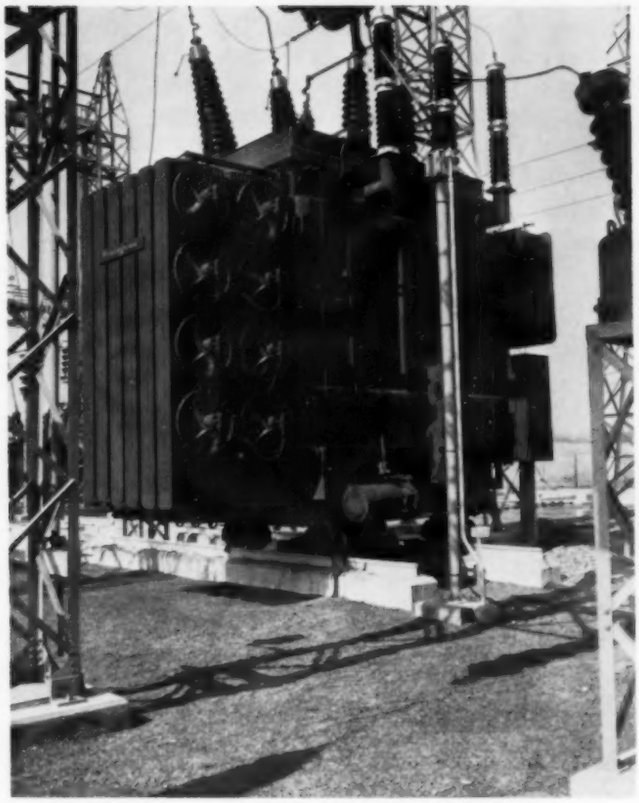
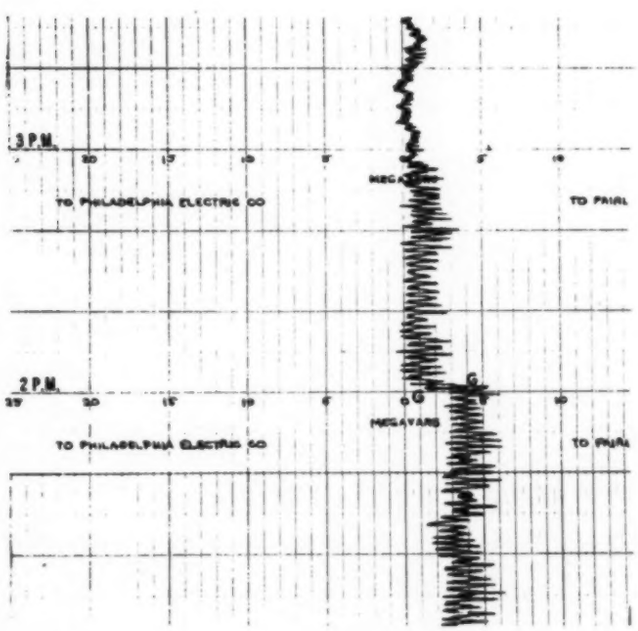


Figure 13 — Reactive power flow may be adjusted by varying voltage of generator bus or by changing taps at interconnection transformers.

damage to or complete loss of a major unit.

Another precautionary protective device consists of underfrequency relays at the powerstation which isolate it and the river pump station from the rest of the system in the event of an unexpected load increase, such as that resulting from sudden loss at the utility company by tripping of circuit breakers on the primary power system. In this case the two remaining substations might feel

Figure 14 — Operators try to average zero reactive power flow.



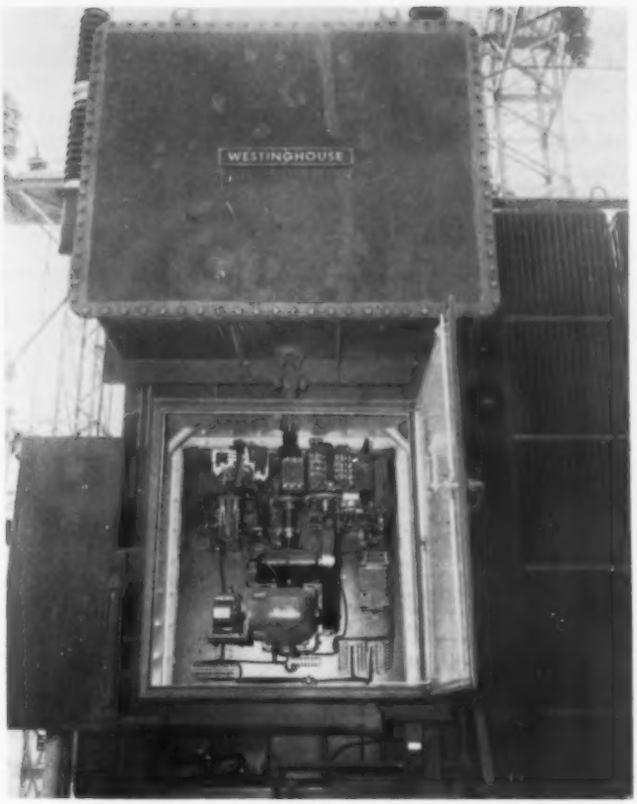


Figure 15 — Transfer contacts are housed in compartments directly above operating mechanism.

the effects of a complete power outage, but the resultant damage could not be as serious or costly as it would if the river pump station and cooling water were lost.

Incipient trouble in the powerstation is anticipated by a pressure gage equipped with an alarm to warn the operators that the steam pressure has decreased to an unsafe value and some load must be dropped. The exact order of "shedding" will be selected by the operator on duty and will vary with individual situations as described above.

General principles and primary considerations which operators are instructed to follow are:

1. Safety of personnel—If a load is to be dropped, warning should be given and the load dropped, studied from the standpoint of possible injury to persons caused by loss of crane power, etc.

2. Maintenance of water facilities—In shedding loads, the river pump station's water pumping facilities must be supplied with power at all times.

3. Maintenance of steam for blast furnaces and water pumping—Possible emergency conditions could result in steam pressure and temperature decreases which would seriously damage turbines. To avoid such damage in a decreased steam pressure condition, generation load must be dropped immediately even to the extent of "tripping" one or both generators off the line. In these emergency steam conditions which will be shown by the pressure gage and annunciator previously described, the available steam must be used for blast-furnace blowing and emergency pump operation.

4. Penalty demand provisions—Large production loads must be decreased or curtailed as rapidly as possible to avoid invocation of power contract penalties.

The severity, measured by the length of any such

outage experienced to date and the frequency, have not been problems. This is shown by the fact that very rarely in three years have power purchases been other than desired nor has there ever been an invocation of the contract penalty provisions for excessive demands or power factor violations. This indicates that in most cases the operational methods are sound and the equipment excellently designed and engineered.

DISCUSSION

PRESENTED BY

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T. S. NOVAK, Superintendent Electrical Dept., Bethlehem Steel Co., Sparrows Point, Md.

H. W. DORSET, Assistant Superintendent Electrical Dept., Bethlehem Steel Co., Sparrows Point, Md.

R. W. SHEFFLER, General Supervisor, Electrical Engineering, Fairless Works, United States Steel Corp., Fairless Hills, Pa.

R. H. TURNER, Electrical Engineer, United Engineers & Constructors, Inc., Philadelphia, Pa.

GEORGE A. GOETZ, General Foreman Electrical Operations, Fairless Works, United States Steel Corp., Fairless Hills, Pa.

J. A. Bruce Pinney: My questions pertain to the 13.8-kv switchgear. First, what is the interrupting capacity of this switchgear? Second, how close is your maximum fault current to this interrupting capacity? Third, do you normally operate with the bus tie breaker closed? Fourth, are bus reactors used to limit fault current?

H. H. Angel: I have several questions. They are:

1. At what top capacity are you operating the two 30,000 units?

2. I assume that in order to operate at a specified maximum capacity in order to reduce the amount of purchased power demand, you must at times burn purchased fuel.

3. Do you generally have to supply much reactive kilovars in order to reduce that supplied by the utility?

T. S. Novak: I noticed from the curves which were shown, that if the system's power factor approached 95 per cent, corrective measures were taken for improvement of the power factor. To be required to make power factor corrections when it deviates 5 per cent from unity, certainly would hinder the operation of any large involved steel plant's power system. We have somewhat of a power factor problem on our 60-cycle system which the local utility has indicated must be improved. This we hope to accomplish by increasing the excitation of our synchronous equipment. We believe we have enough synchronous equipment to improve our power factor without having to resort to some expensive corrective measure.

H. W. Dorset: "It would appear that you operate with your bus; that is your A and B power bus separated and apparently with the bus ties open. You must find it at times rather difficult to switch your load. You apparently cannot transfer load from one bus equally between the two transformers without shutting down your system. This is the only question I might ask.

R. W. Sheffler: In casting back about five or six years, when we were thinking about the type of power system to install at Fairless, we considered six different possibilities for this plant. This is almost a take-off of a power system in the Chicago district. There is one item added, though, that I do not believe has paid its way, that is, the high-voltage tie switches ahead of the transformers, which may not be worth the money we put into them, and the maintenance that is created by them.

R. H. Turner: The layout showed some of the features that were incorporated in the 69-kv system which we recommended for 60-cycle system in the Chicago district, and the basic plan is very similar.

George A. Goetz: Some of the questions can best be answered with the diagram of the system shown in Figure 2.

Mr. Angel asked about the levels at which we operate the two 30,000-kw units and the question of fuel usage in the power station, as well as the extent of fuel usage for generation. The amount of load on each of the two 30,000-kw units will vary with the mill operations. We will go from a full 60,000-kw generation at our biggest mill load down to a minimum load requiring 30,000 kw total generation. These are minimums such as those which occur Christmas Day or Christmas Eve. The first turn Christmas Day we divided a total load of possibly 30,000 kw between the two machines. These represent broad limits, but our operating problem is of such nature that we must vary our amount of generation with whatever mills are operating.

A complete answer to the question of purchased fuels would involve a lengthy discussion of both the fuels and power contracts with the utility company. We generate primarily from waste fuels rather than fuels purchased from outside sources. I cannot explain here all of the intricacies of the contracts by which this is controlled.

The interrupting capacities of the 13.8-kv circuit breakers and possible fault currents vary. The details of normally closed bus ties to this group show in Figure 2. The bus tie circuit breakers are normally operated closed, whereas bus tie air-break switches are normally operated open. In the case of the generator buses which supply some mill load, at 13,800 volts, the distribution buses are separated from the generator buses by two reactors which show on Figure 2.

The questions as to the value of the tie air-break switch, and the questions of how the system is engineered, as well as the questions of how it is operated, are food for discussion. We operate by the principle that air-break switches, (disconnects) must not interrupt large currents. We feel that they can be expected to magnetize transformers, but that is all we attempt to do with them. For that reason if we want to transfer a load (put one transformer on the other transmission line), we must completely unload the transformer by tripping the secondary breaker, opening the primary switch, and reclosing the secondary breaker to pick up

load after having reclosed the primary switch. The question as to whether that is worth doing or not is one which can be best evaluated in terms of experience and all the economic features going into the station design.

Obviously if we had primary oil-circuit breakers for paralleling, we would not have to go through that unloading procedure although, we would have quite a complicated relaying and protective tripping scheme. We have only in one case that I know of ever desperately wanted to unload completely one transmission line.

We have frequently, for maintenance purposes, wanted to unload one of the buses. In that case it is nice to be able to put the transformer over on the other transmission line. The dispatcher will plan such a transfer and put it into effect when the load through the station will justify or allow it. If he has a full load through the station on second turn, and knows the operation is coming up, he will make the transfer on one of the other lighter loaded turns.

In answer to the question on reactive power, we would emphasize that most of our correction is obtained through the taps of the interconnection transformers as shown in Figure 14. Of course, when charging these taps, we are only "left-handedly" increasing and decreasing the reactive load on the two generators. However, we are now trying to work more towards corrections with synchronous motors at distribution substations. The effect there will be to hold the voltage up, out on the primary power system rather than to take a decrease at the interconnection transformer, then pick up the slack at the back end of the system.

The detailed answer regarding circuit breaker interrupting capacity involves a great number of circuit breakers and the dependence of fault currents on switching arrangements as well as the wide variation in such fault currents. Generally speaking, however, distribution circuit breakers such as those on 213A3, 313A6, 513B9, etc., in Figure 2 are of 500,000-kva interrupting capacity and generator bus breaker such as 513GA in Figure 2 are of 1,500,000-kva capacity. We do not believe it would be useful or valuable to list all of the interrupting ratings of the feeders shown in Figure 2.

The Development of Optimum Ingot Sizes For Flat Rolled Products*

By J. G. SIBAKIN

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▲THE mathematical analysis of the operations of the hot strip mill can be the basis for the establishment of the conditions for the physical balance of the mill and for the selection of optimum slab sizes for a given mill.

On the basis of slab sizes, optimum ingot sizes for flat rolled products can be developed from the point of view of the best possible rolling practices, metallurgical temperature considerations and open hearth practices.

The relationships developed in this manner will indicate the quantitative interdependence of finishing speed, finishing temperature, tail end temperature, entry temperature into the continuous train, rolling time in roughing equipment, etc. This information will be useful for the development of rolling practices and may be used as a guide to estimate the adequacy of the powering equipment. It can serve as the basis for the establishment of the possible capacity of the mill in tons per hour.

The application of the suggested method makes it possible to select the slab sizes to satisfy any selected tail end temperature of the coil, depending upon the metallurgical requirements.

The sequence of the steps that can be followed in a given mill for the development of the relationships as outlined above and the establishment of optimum slab and ingot sizes and rolling practices are as follows:

a. Establish the head end finishing temperature of a coil as a function of finishing speed, ordered gage and entry temperature.

b. Establish the head to tail end temperature differential for the coil as a function of finishing temperature (head end), finishing speed, ordered gage and coil length.

c. Combine the relationships of steps "a" and "b" to obtain coil length as a function of tail end temperature, entry temperature, ordered gage and finishing speed. The selection of the tail end temperature establishes the minimum temperature of any point of the coil and introduces a restriction from a metallurgical point of view.

d. Establish the entry temperature as a function of the rolling time in the rougher, the thickness of the bar and, possibly, the furnace temperature.

e. Establish the rolling time in the rougher as a function of the slab thickness, width and length.

f. Establish the relationship between mill load and draft, slab thickness and width. The application of full admissible loads will permit determination of the heaviest possible slab that can be handled by a given equipment.

g. Select the most common band width rolled in the mill. Now the relationships developed for the finishing train and roughing equipment can be expressed in units of weights.

h. Superimpose graphically the relationships of steps "e" and "d" so as to obtain the conditions of the physical balance of the mill.

i. Plot into graph "h" the possibility of the roughing equipment in terms of entry temperature and coil weights. The relative position of the weights obtainable from the rougher in the gage grid will indicate the optimum slab size and can be a guide for the adjustment of the mill equipment.

* Summary from paper presented at Buffalo Regional Technical Meeting of the AISI, September 25, 1957.

Industrial Statistics Help Solve Steel Plant Managerial Problems

by
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and
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. . . . operations research is a new tool which will help management make sound decisions . . . it will minimize over-all costs and provide accurate over-all plant data . . . .

▲ IN recent years, important tools gleaned from the disciplines of the mathematical and statistical sciences have demonstrated their value in the solution of problems confronting the industrial manager.

Most managers are familiar with the staff functions of quality control and market research which employs as major operating aids the techniques of applied statistics. Perhaps fewer are aware, however, of the newer areas of application being served by the mathematical sciences. The more recent development of methods embodied in operations research or operations engineering suggests the broad scope of problems to which mathematical and statistical tools can be fruitfully applied. The statistician now finds that he can be helpful in such diverse problem areas as inventory control, production scheduling, preventive maintenance, capital expenditure analysis and long range planning.

The skillful manager, too, has learned that the employment of these staff services can frequently bring new perspective on the chronic problems facing industrial management. Are overtime costs too high, should we reduce our brick inventory, how can mill delays be reduced? These questions continue to tax the judgment of the most experienced steel plant executive. Although it would be naive to assume that the techniques of operations research will ever replace managerial judgment, a quantitative approach as exemplified by operations research can frequently serve as a useful adjunct. Because of the vital place that statistical techniques occupy as a tool of operations research, primary emphasis will be placed during the remainder of this paper upon these specific methods. It is, of course, realized that other mathematical techniques can be of equal or greater value depending upon the particular problem at hand.

Lukens Steel Co. has only recently assembled a small operations research unit, whose function is to assist management in the solution of problems amenable to quantitative evaluation. The purpose of this paper is to demonstrate by way of actual case histories, the method of attack and the various techniques employed in the solution. Although exceeding elementary concepts, the methods used were not highly sophisticated insofar as statistical theory goes; they did display a fair degree of flexibility in coping with a variety of problems. Some of the detail and most of the statistical theory have been omitted from this presentation in order that the reader may better grasp the salient points or "spirit" of the methodology without being encumbered with the possibly foreign terminology of the statistician; knowledge of basic statistical concepts, however, is assumed.

CASE 1. DETERMINATION OF OPTIMUM PROVIDING ALLOWANCES

One of Lukens Steel Co.'s products is clad steel plate, a composite plate made up of varying percentages of stainless, nickel or inco alloy and the remainder comprised of carbon steel, the bond being secured through the application of heat and pressure during the rolling process. These plates are produced to customer order and are available in thicknesses ranging from $^3/_{16}$ to 2 in. and upwards in width and length combinations from 30 to 500 in. The plates are customarily produced in pairs involving a 5-layer "sandwich" composed of carbon-stainless-parting compound-stainless-carbon. The four slabs with parting compound placed between the opposing stainless surfaces are assembled, welded around all edges, heated, rolled and cut apart resulting in two finished clad plates.

The job of the clad steel "provider" is to take customer finished plate requirements and, working back, determine the size of the slabs which, when rolled out, will supply the rectangular patterns ordered. The vagaries of the assembling, heating, rolling and shearing processes are such that the provider must add certain allowances to the ordered sizes so as to end up with a pattern large enough to meet the customer requirement without incurring "too much" excess metal which must be scrapped.

In essence, the preceding statement describes the

basic problem. If the provider adds too much safety allowance, he incurs an unnecessary amount of scrap most of the time. If he provides "tightly" he runs a certain risk of coming up with a finished plate the dimensions of which are under the ordered pattern. In this latter instance, the customer's original order must be re-processed, involving delivery delay and good will loss; in addition, the original plate must be stocked in anticipation of another order coming in for which the stocked plate would be suitable; this incurs costs of storage, capital tie-up and possible subsequent cutting loss. What provision practice, then, should the provider follow so as to balance, over the long run, the foregone profit resulting from low yield and surplus scrap versus good will loss and storage costs of short patterns?

A study of the situation revealed that the clad process could be characterized by a probability model involving the following four basic elements.

1. There exists some probability that the roller will roll the clad pack or "sandwich" wider or narrower than the width specified.
2. There exists some probability that the roller will roll heavier or lighter than the pack gage specified.
3. Given roller performance, there exists some probability that good clad will fail to roll out to the theoretical length specified.
4. Given roller performance, there exists some probability that good clad will fail to roll out to the theoretical width specified.

Note: In elements (3) and (4) one is concerned with length and width of the largest clad *rectangle* produced. Failure to roll-out means that the edges produced require shearing. The resultant rectangle is usually substantially less than the over-all plate dimensions inasmuch as "bottle shaped" plates or "fish-tails" may be produced which require trimming to rectangular form.

The behavior of these four probability distributions taken in concert is rather interesting. The roller, for example, may roll somewhat wide on width and light on gage (but still within commercial gage tolerances) so that the resultant theoretical length will vary little from that which would have obtained from his rolling to specifications. This length, however, may then be subjected to an extreme process deviation resulting in a possible "lost" plate. The character of these distributions is shown in Figure 1 for one gage and type classification; these distributions represented the results of a past year's production. Figure 2 shows graphically the type of situation which the provider faces.

Tests for mutual independency of the four distributions shown in Figure 1 indicated the following results:

A. Distributions 1, 2 and 4 were mutually independent and also were independent of the length and width of the plate being provided; i.e., all plate sizes of chrome-nickel clad $\frac{3}{8}$ in. through $\frac{1}{2}$ in. thick could be subjected to the same distributions.

B. Distribution 3, however, was not independent of the plate length and width; in general, the longer and wider the plate the less length roll-out in inches (or the greater the *deviation* from theoretical roll-out) was to be expected. As such, what the roller did (distributions 1 and 2) affected to a nominal degree what occurred in distribution 3. (It will be noted in distribution 3 of Fig.

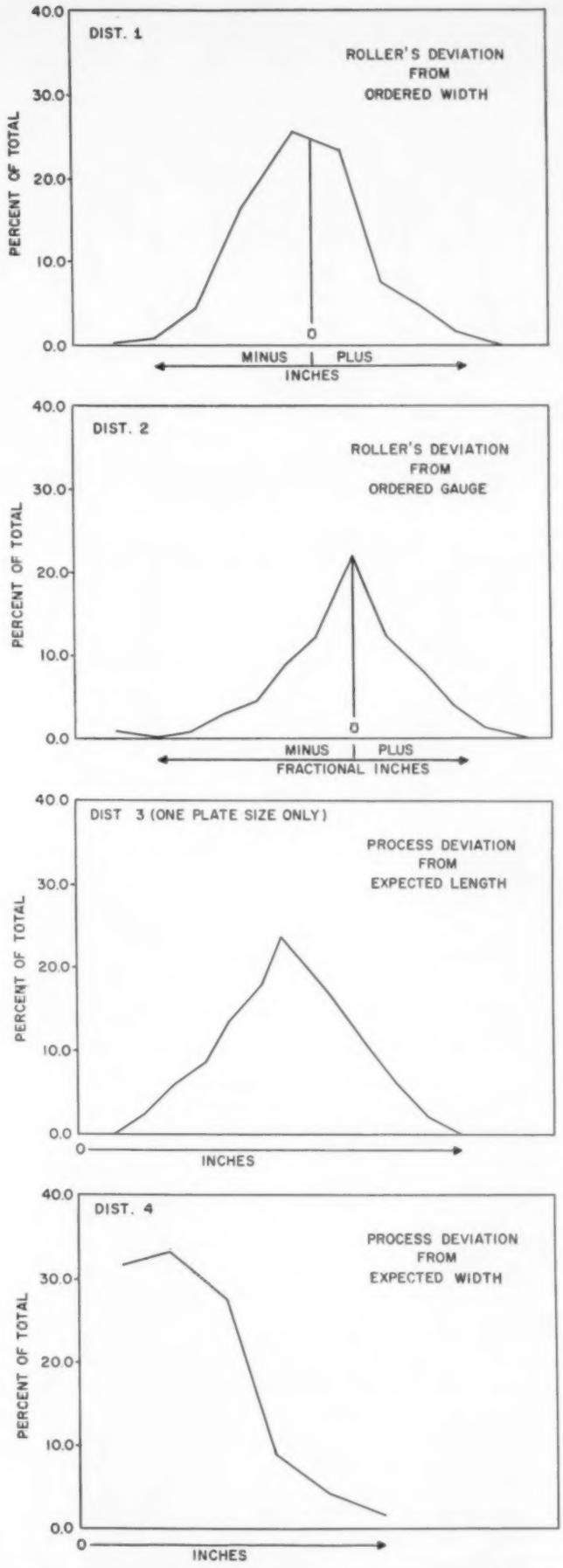
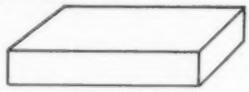


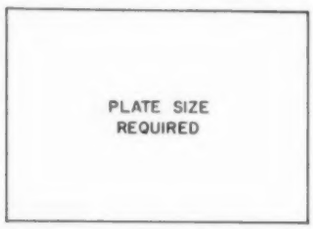
Figure 1 — Chart shows frequency polygons based on full years production of $\frac{3}{8}$ through $\frac{1}{2}$ in.-gage chrome-nickel-clad plate.

1 that only one plate size is shown. Actually a "family" of curves were derived for this distribution whose arithmetic means were a function of plate length and width dimensions; this relationship is shown in Figures 3 and 4. Analysis of our past data indicated that we could employ a multiple regression equation (estimated from this past data) to indicate what we could expect to happen on length roll-out for a particular plate size. Inasmuch as our regression equation did not fully explain the total variance, we could then use the calculated standard error of the estimate and a set of random *normal* numbers to superimpose random error on the value estimated from the regression equation.

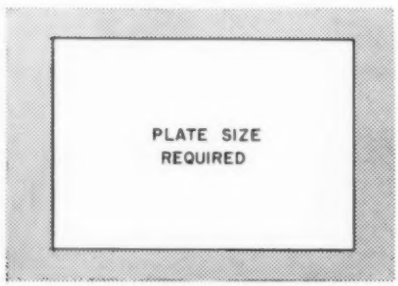
Figure 2 — Sketches show types of problems which must be solved by clad provider.



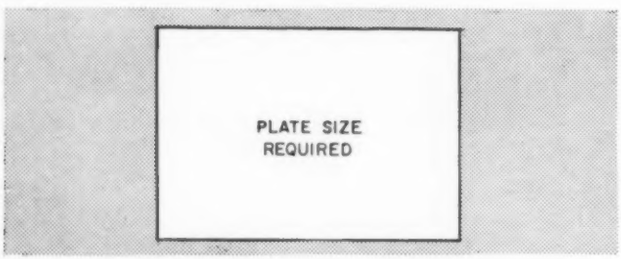
1. CLAD PACK (WHAT ALLOWANCES ARE NEEDED ?)



2. CUSTOMER PATTERN REQUIREMENT

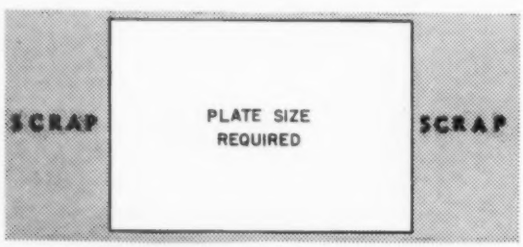


3. PROVIDER ADDS AN ALLOWANCE



4. POSSIBLE ROLLING PERFORMANCE
(ROLLED LIGHT ON GAUGE AND NARROW ON WIDTH)

5. POSSIBLE PROCESS PERFORMANCE



6. LARGEST RECTANGLE AFTER SHEARING

C. Gage ranges and type of alloy used in the cladding affected the statistics of all four distributions. In effect, there were 12 separate sets of four distributions each (four gage classes times three types of alloy). For illustrative purposes, however, we will deal with only the gage classification $\frac{3}{8}$ through $\frac{1}{2}$ in. (finished plate gage) for chrome-nickel stainless cladding. The remaining 11 sets were handled analogously.

At this junction of the study, we were able to set up a model for this operation. As it actually turned out two models were employed.

Systems simulation—The character of the empirically derived frequency distributions was such that the normal (bell-shaped curve) was only approximated; this point served to make the combination of the distributions a rather complex one mathematically. However, we could ask this question: suppose we were to make some "good guesses" concerning the allowances to be added to specific pattern requirements and then simulate performance by sampling from our frequency distributions a large number of times, keeping track of what percentage of the orders would be lost through failure to make pattern—how would these alternate allowances behave?

This, in essence, is what we did. Using the advantage of an electronic computer, alternate providing allowances were subjected to our "paper" environment for a number of runs corresponding to several years of experience had we used the particular set of allowances under test. By determining the rejection rate under each alternate tested we could then derive the cost for (1) material scrapped and (2) storage cost of short patterns.

Our final task was to evaluate a "good will" loss through failure to make every pattern. The determination of good will loss is a difficult problem to say the least. What we were able to do, however, was to calculate the cost involved in excess scrap generation for each alternate. Management then could say: if I choose that set of providing allowances which over the long run will result in only 3 per cent dimensional rejects (larger safety allowances) rather than say 5 per cent, it will cost "x" number of dollars per year in terms of extra scrap generation. If the additional good will is worth at least this sum, it is preferable to choose the 3 per cent reject rate. In a sense, a good will factor is quantitatively *imputed* by indicating how much is foregone through its adoption.

The simulation showed further versatility. One could determine the effect of reducing rolling tolerances on the generation of rejections vs yield and thus derive the pay-off if rolling tolerances were tightened. In short, we found that accepting a rather small percentage of rejects for intended orders would improve yields markedly without appreciably affecting good will. This

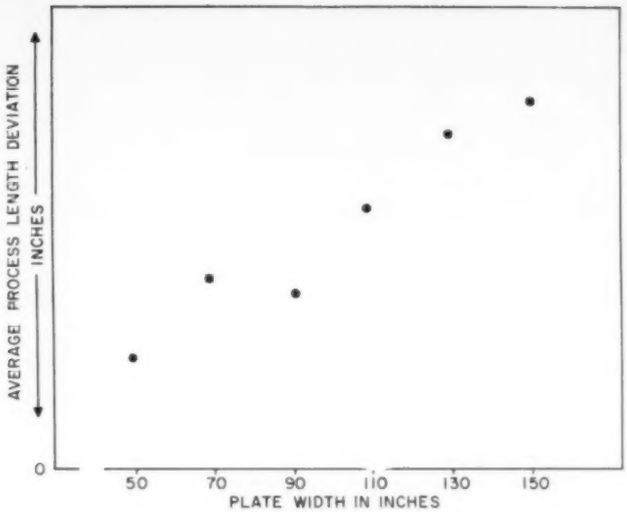


Figure 3 — Chart gives data on the process length deviation (average) with respect to plate width.

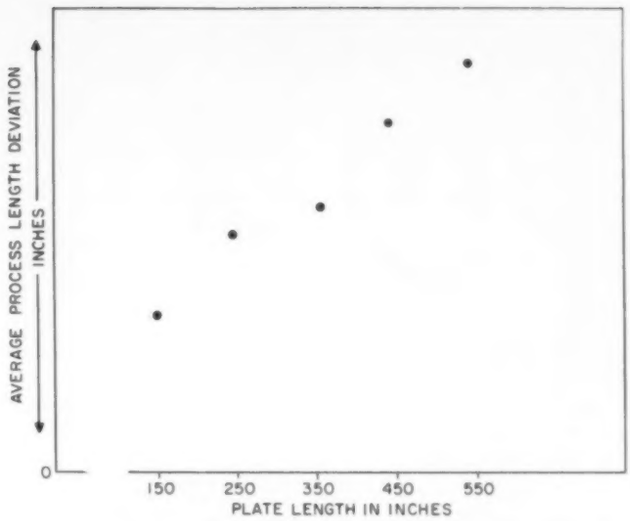


Figure 4 — Chart gives data on the process length deviation (average) with respect to plate length.

compares with an existing policy of always providing to the high side so that no dimensional rejects occurred, but scrap generation was high and corresponding yield low.

In addition, we found that a good medium for "feedback" existed. By periodically sampling actual performance for each of the frequency distributions, we could alter providing allowances to compensate for changes in rolling and/or process performance. Thus, this particular procedure became a flexible method with which to cope with changes in the environment. The prime advantage, of course, is that forecasted behavior under any providing allowance chosen is made available before any plate (in the physical sense) is made.

Analytical Model—By making a simplifying assumption of normality in the frequency distributions, analytical techniques were capable of being fairly easily developed. A thorough discussion would unduly add to the length of this paper; suffice to say that we were able to approximate rather closely our simulation results by analytically combining the various probability distributions. The obvious advantage in this instance was to cut down on a large amount of expensive computer time. In practice, we now employ a combination of both simulation and analytics, the latter being employed for interpolation purposes.

CASE 2. INVENTORY CONTROL OF SILICON CARBIDE ROLLS

In certain of Lukens heat treating facilities, rolls made of silicon carbide are used as a plate transport medium. Due to physical and thermal shock, these rolls require replacement from time to time; in the past our inventory had been "feast or famine" in that (due to the variable rate of furnace activity) we frequently had too many cylinders on hand (incurring costs in storage and capital tie-up) or else we were in a dangerously low position with the threat of a stockout being imminent. In addition, we incurred costs of ordering as well as storage and capital tie-up expense. With this situation in mind, the following questions were posed:

1. What is the economic purchase quantity of silicon carbide rolls which will minimize the sum of carrying and procurement costs?
2. What should the safety allowance (protective stock) be so as to reduce the chance of a stock-out to virtually zero?
3. What technique can be employed so as to adjust economic purchase quantities or safety allowances for changes in either average usage or more dispersed usage?
4. Based on anticipated price increases, what should their magnitude be so as to warrant the purchase of larger quantities than operating needs?

The theory of economic order quantities is well covered in the literature (see references at the end of this paper). Figure 5 shows the behavior of carrying costs and procurement costs for alternate purchase quantities for this specific case.

Algebraically, the following expression was employed:

$$Q = \sqrt{\frac{2YS}{CI}}$$

where:

Q = Economic purchase quantity in units.
Y = Annual usage in units.
S = Procurement cost per order placed.
C = Unit cost of roll.
I = Carrying cost of average inventory.

In our particular instance Y = 1800 rolls; S = \$20; C = \$43.75 and I = 10 per cent or, decimally, 0.1.

Solving the above expression, the economic purchase quantity equalled 128 rolls. However, as is typical in many industrial situations, we were faced with a freight discount structure for full truckload shipments. The minimum quantity to qualify for this discount represented 190 rolls. If this truckload shipment were ordered, a freight saving of \$0.55 per roll would be realized. Our next problem was to evaluate the original policy cost without consideration of freight discounts with this new factor to indicate whether it would be worthwhile to deviate from the old policy. For this

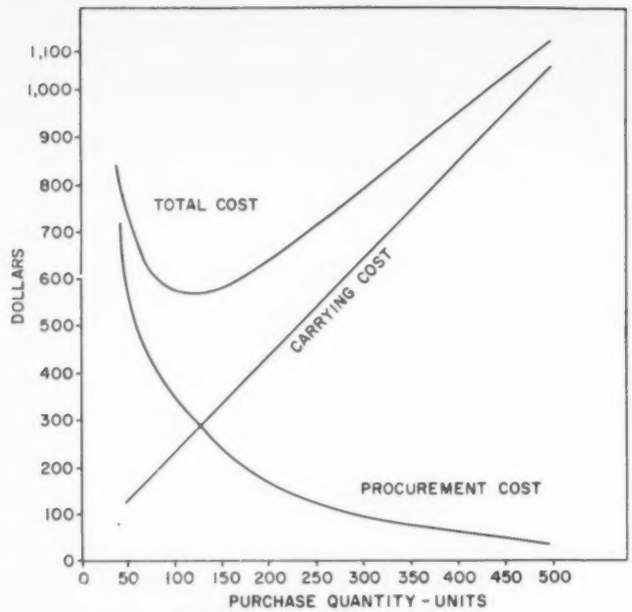


Figure 5 — Chart shows annual inventory cost for various alternate purchasing policies.

purpose, the following expressions were employed:

$$\text{A. Old policy cost (OPC)} = \frac{QCI}{2} + \frac{YS}{Q}$$

$$= \frac{128(43.75)(0.1)}{2} + \frac{1800\ (20)}{128} = \$561$$

$$\text{B. New policy cost (NPC)} = \frac{Q'C'I}{2} + \frac{YS}{Q'}$$

$$= \frac{190(43.20)(0.1)}{2} + \frac{1800(20)}{190} = \$599$$

If we ordered in full carload shipments we would save \$990 annually (\$0.55 × 1800). The cost of deviating from our original quantity is only \$38 (\$599–561). Hence it definitely was to our economic advantage to purchase full truckload lots; our new economic purchase quantity became 190 rolls.

Safety allowance—At this point in the analysis we had determined how many rolls to order, but we were now faced with the problem of when to order. The time lapse between order placement and receipt (lead time) for this item amounted to four weeks. During that period of time we desired to have on hand enough rolls to cover not only expected demand during the lead time, but a cushion or safety allowance to cover adverse fluctuations in average demand.

Analysis of the past data indicated that we could expect a stock-out only one four-week interval out of one hundred or a 1 per cent risk of run-out if we employed a safety allowance of 27 rolls; the selection of the 1 per cent risk level was in accordance with management's appraisal of the seriousness of a stock-out for this particular item.

Our plan of ordering was now complete. Under this arrangement we would order our economic purchase quantity of 190 rolls every time our stock on hand reached 166 rolls which represented the sum of average demand per four week interval, or 139 rolls, plus the safety allowance of 27 rolls. (For purposes of brevity, the interaction of safety allowances and economic purchase quantities on lowest *total* policy cost will not be covered; in this instance little cost improvement would accrue from this refinement.)

Control charts—At this juncture, we could call upon a technique so familiar to the quality control analyst, the control chart. Although our past usage data probably represented the best estimate of short term anticipated usage of silicon carbide rolls, we desired to additionally incorporate a feed-back device to inform us of future changes in either average usage or dispersion about that average. Statistical control charts fulfilled this need and yielded signals upon which either the economic purchase quantity, safety allowance, or both could be adjusted to reflect changing conditions.

Anticipatory price changes—To complete the analysis we also prepared tables showing when the purchasing agent should deviate from the original ordering procedure assuming price increases were anticipated. (See Reference 7.)

The answer to this question involves balancing the higher carrying costs against the reduced procurement costs and costs later incurred through purchasing at a higher price by ordering larger quantities prior to the

Figure 6 — Accumulative probable distribution of demand and absenteeism shows percentage of weeks in which weekly man-hour demand exceeds levels above figures on abscissa.

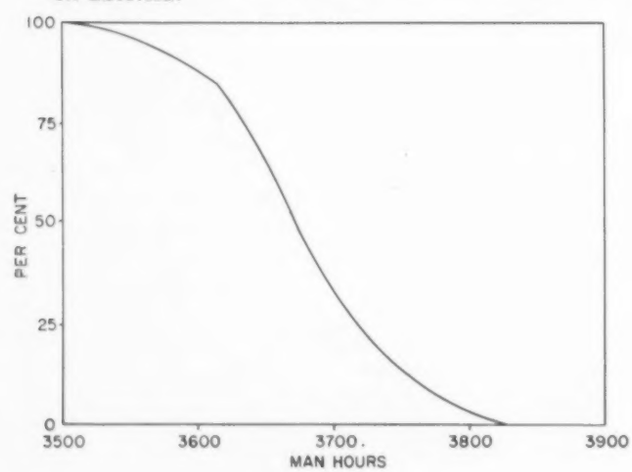
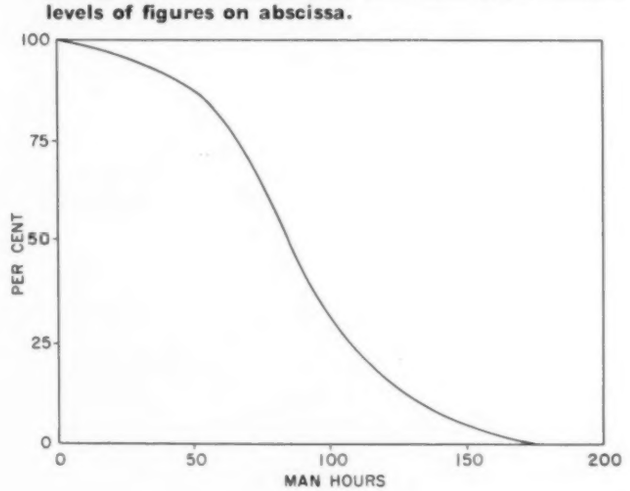


Figure 7 — Accumulative probable distribution of demand and absenteeism shows percentage of weeks in which weekly lost man-hours (due to absenteeism) exceeds levels of figures on abscissa.



anticipated price increase. Also, corresponding tables could have been prepared for the less realistic situation, a price decrease.

CASE 3. OPTIMUM MANNING LEVEL FOR A SERVICE DEPARTMENT

A service department exists at Lukens for the purpose of recording production and time of the various personnel included under wage incentive plans. This department, known as the standards checking department, consists of salaried personnel who, nevertheless, receive time and a half for all hours worked in excess of 40 per week. The nature of Lukens operation is such that the demand for checking services is variable from week to week. Although vacations are covered by temporary summer employees, absenteeism represents a pertinent factor entering into the analysis. If too few employees are maintained, overtime costs will be incurred. If too many employees are maintained, the "idle" time is utilized in training programs, but salaries must still be paid for essentially nonchecking work. The problem was thus to determine the proper manning level so that the incremental cost of adding an employee would just equal the incremental profit (in terms of avoidance of overtime costs) gained through the employee's addition.

From past data on weekly checking demand and absenteeism (both in terms of man hours), we were able to construct frequency distributions as shown in Figures 6 and 7. For this specific problem, hiring costs were deemed negligible and could be excluded from the calculation. Management did wish to know, however, as a by-product of the study, the expected number of "idle" hours annually incurred for different size work forces, in order to match this figure against training needs. A further requirement was to estimate the annual cost incurred in deviating from the optimal number of employees if, for training purposes, it was desirable to add more employees than the lowest cost solution provided.

With the foregoing in mind, we were able to construct an equation which would yield us total annual costs for each crew size under consideration:

$$TAC = 2080\ MC_1 + 52\ P\ \phi(M)\ C_2$$

where

- TAC = Total annual costs with specific force sizes.
- M = Size of force in terms of men.
- C_1 = Cost per straight time hour.
- P = Proportion of weeks in which overtime would be required.
- $\phi(M)$ = Average weekly overtime hours which would be incurred during the proportion of weeks requiring overtime; this is a function of the manning level.
- C_2 = Cost per overtime hour.
- 2080 = Number of hours paid for per year for each man or 40×52.
- 52 = Number of weeks per year.

From our probability distributions we were able to find both P and $\phi(M)$ for each force size. As a by-product, we also found the number of "idle" hours for each manning level. Using $C_1 = \$2.50$ and $C_2 = \$3.75$ we were then able to substitute in our equation for the various levels of work force. These results are shown in Table I.

TABLE I
Cost Calculations

Force size, men	Fixed cost annually	Overtime cost annually	Total cost annually
97	$504,400	$ 129	$504,529
96	499,200	564	499,764
95	494,000	1,818	495,818
94	488,800	4,610	493,410
93	483,600	9,322	492,922
92	478,400	15,585	493,985
91	473,200	22,776	495,975

As can be noted from Table I, a manning level of 93 men represented the lowest total annual cost. At this level the incremental cost of $5200 provided an incremental gain of $6263 in terms of foregoing overtime. (Actually, the "true" optimum would have been between 93 and 94 men.)

When "idle" hours for training purposes were calculated, however, it was found that in management's judgment this work force size yielded an insufficient number of such hours. However, the addition of an extra man (from 93 to 94) would incur an added cost of only $488; it was decided that the extra hours available for training justified this cost. Hence, a qualitative factor (training hour requirements) was imputed costwise by determining the additional annual cost which would thereby be incurred. This roundabout way of quantifying a judgment factor is one of the chief benefits that operations research can provide.

SUMMARY

The cases presented above by no means exhaust the areas of interest in which statistical analysis can prove useful. In our operation these tools have been additionally employed in:

a. Determination of inventory levels of ingot molds.
b. Establishing the feasibility of warehousing certain types of products.
c. Auditing of time standards in connection with incentive plans.
d. Scheduling of planned equipment shut-downs.
e. Evaluation of alternate purchasing policies on base LIFO inventory procedures.

The field of operations research is certainly a growing one. The reader who would like to learn more about its nature, will find references in the Bibliography.

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COKE AND BY-PRODUCTS IN 1956

By I. E. MADSEN

. . . . data and material in this report are based on information or quoted from Mineral Market Reports M.M.S. No. 2645 dated June 1957 . . . .

▲ REFLECTING the strike which occurred in 1956, coke production reported to the Bureau of Mines, United States Department of the Interior, was down one per cent from 1955 and six per cent from the record high set in 1953. Since most furnace oven-coke plants were forced to bank their operations or to operate at reduced rates during the strike, which lasted from July 1 to August 5, the new record which had been expected was not established. Coke production during the 34-day work stoppage was only 27 per cent of capacity at furnace plants and was also reduced at merchant plants to 71 per cent of capacity. However, the production rate for all oven-coke plants for the whole year was 90 per cent compared with 93 per cent in 1955.

The production rate in 1956, except during the work stoppage, continued at about the same rate as the last quarter of 1955. The beehive ovens, which since the end of World War I had operated only as marginal producers, furnished only three per cent of the output in 1956. Practically all of the beehive production in 1956 was used for smelting iron ore in blast furnaces.

The high rate of industrial activities which started late in 1955 continued throughout 1956 and kept requirements high for metallurgical coke. Production also kept up with demand and inventory increased only 600,000 tons during the year. Coking usage in 1956 was about the same as previous years with the blast furnaces and foundries using the largest part of the total production. About 90 per cent of all coke used and sold by producers went into blast furnaces. Significant of the quantity of coke produced and the improvements in blast coke operation are the AISI figures which show that only 1791.1 lb of coke were consumed per ton of pig iron and ferroalloy produced in 1956. This figure is the lowest on record and compares with 1761.3 lb in 1955.

Some four per cent of all coke shipments in 1956 was used by iron foundries and this is about the same percentage which iron foundries consumed in 1955. The proportion of coke used for manufacturing producers of gas and water gas which has been going down in the past two years was but two per cent of the total. Coke for other industrial purposes amounted to three per cent and residential heating consumed about one per cent of the coke.

Annual coke capacity of oven-coke plants changed but little in 1956. New coke capacity of 1,758,200 net tons from 302 new ovens was placed in operation during the year, however, some 418 old ovens were taken out of production, either for rebuilding or permanently abandoned. As a result there were 116 less slot-ovens in existence on December 31, 1956 than at the end of the previous year. Total capacity at the end of the year was just under 80,000,000 or 79,955,100 tons for the by-product ovens which was an increase of 289,600 tons over the year before. Appreciable additional capacity was scheduled, since some 631 ovens to be rated at 3,300,000 tons were under construction. The modernization and construction program which has been taking place since World War II has resulted in marked improvements in coking operations and production. Over 40 per cent of the ovens in operation at the end of the year in furnace plants were less than ten years old. On the other hand, in merchant plants replacements have not been an important factor as only some 15 per cent of their ovens are less than ten years old.

By-product material production was also down slightly during the year being generally proportional to by-product coke production since changes in yield

were only minor. Coke-oven gas decreased three per cent, ammonia decreased seven per cent, crude tar decreased two per cent and crude light oil decreased two per cent. An important development in ammonia production is that some two additional coke plants began making diammonium phosphate instead of ammonium sulphate. There are thus now three plants making diammonium phosphate in the coke industry. Sales of coal chemicals have in general kept pace with production and, in a number of cases, inventory has been reduced. Ammonium sulphate sales particularly were higher than production in the spring and late fall and reduced the high inventory present at the beginning of the year. However, the decline in the production of phthalic anhydride reduced markedly the demand for crude naphthalene in the higher grades (76 to 79 C) and inventory of this material went up thirty per cent by the end of the year. Sales of the light-oil derivatives or benzene, toluene, xylene and solvent naphtha were in line with production, and there was very little change in the inventory of these items during the year.

Prices of the light oil and tar derivatives changed only slightly during the year. Crude tar price increased however $0.005 a gallon but ammonium sulphate prices dropped sharply in May. The price cuts in ammonium sulphate reduced the average return per ton to $32 in 1956 from $38 in 1955. The total return from the sale of coal-chemical materials dropped nearly $7,000,000 dollars from 1955 totaling $341,628,-908. Additional statistics are covered under the respective topics in Tables I, II, III and IV and in the following sections.

PRODUCTION OF COKE

In 1956 daily production of by-product averaged 197,000 tons compared with 202,000 tons in 1955. Beehive production averaged 6,760 tons per day, appreciably higher than 4720 tons per day in 1955. The leading state in production of by-product coke was Pennsylvania. The other important states listed in the order of their production were Ohio, Indiana, Alabama, West Virginia, New York, Michigan and Illinois. The first five states produced 69.0 per cent of the national production of oven coke compared with 69.7 per cent in 1955 or almost the same proportion as the previous year. Coke production in 1956 by states followed the same order as in 1955. Pennyslvania was also the leading producer of beehive coke in 1956 with 2,005,590 net tons compared with 1,313,694 net tons in 1955. Pennsylvania production of beehive in 1956 was therefore 81.3 per cent of the total, appreciably greater than the 76.7 per cent which was its share in 1955. Other producers of beehive coke in 1956 were Virginia, Utah, West Virginia and Kentucky.

Pennsylvania was the leading producer of all coke with 21,103,996 or 28.3 per cent of the country's total, a slight increase over the 27.6 per cent in 1955.

TABLE I

Statistical Trends of the Coke Industry in the United States

	1937	1953	1954	1955	1956
Production					
Oven coke, net tons	49,210,748	73,593,528	59,061,442	73,584,214	71,992,242
Beehive coke, net tons	3,164,721	5,243,329	601,054	1,717,612	2,462,022
Total, net tons	52,375,469	78,836,857	59,662,496	75,301,826	74,454,264
Per cent oven coke	94.0	93.4	99.1	97.7	96.8
Stocks of coke, end of year, net tons	2,595,287	2,679,708	2,948,840	1,700,771	2,334,441
Exports, all coke, net tons	526,683	520,252	384,377	530,505	655,717
Imports, all coke, net tons	286,364	157,318	115,781	126,342	130,955
Indicated consumption, all coke, net tons	51,271,929	77,695,872	59,124,768	76,145,732	73,295,832
Disposal, all coke sold or used:					
Furnace coke, net tons	36,751,969	69,728,500	51,973,401	68,171,966	66,311,598
Foundry coke, net tons	2,038,822	3,040,971	2,568,561	3,253,927	2,951,776
Other industrial coke (including producer and water gas), net tons	4,597,894	4,006,560	3,472,132	3,848,674	3,639,131
Domestic coke, net tons	8,107,518	1,467,962	1,266,722	1,126,065	912,436
Carbonizing equipment					
By-product ovens in existence, end of year	12,718	15,989	15,891	16,039	15,923
Beehive ovens in existence, end of year	12,194	15,092	12,216	10,104	9,549
By-product ovens under construction, end of year	259	779	490	261	631
Cost of coal charged, oven-coke plants average per ton	$3.74	$9.24	$9.00	$8.84	$9.35
Prices of coke:					
Average realization on oven coke sold (merchant sales)					
Furnace coke	$4.34	$16.37	$13.83	$14.33	$15.70
Foundry coke	$8.47	$23.87	$23.40	$23.75	$26.50
Other industrial coke (including water gas)	$6.08	$14.00	$12.70	$12.96	$14.35
Domestic coke	$6.53	$15.25	$14.83	$15.10	$16.30
Yield of by-products per ton of coal charged					
Tar, gal	8.67	7.90	8.46	8.13	8.15
Ammonium sulphate or equivalent, lb	21.84	20.09	21.09	20.06	19.28
Crude light oil, gal	2.86	2.90	2.98	2.91	2.92
Surplus gas sold or used, M cu ft	6.66	6.41	6.58	6.58	6.49
Average gross receipts for by-products, per ton of coke produced					
Crude tar sold and used (exclusive of amount used by producers for own use in refining and topping and exclusive of tar derivatives)	$0.502	$0.806	$0.923	$0.840	$0.912
Ammonia and its compounds	$0.326	$0.536	$0.605	$0.502	$0.448
Crude light oil and its derivatives (including naphthalene)	$0.435	$1.247	$1.249	$1.200	$1.213
Surplus gas sold or used	$1.483	$2.005	$2.178	$2.120	$2.102
Total coal-chemical materials (including breeze)	$2.974	$5.19	$5.57	$5.62	$5.10

Pennsylvania's total coke production was also greater than the 20,802,687 tons produced in 1955 which trend was contrary to the over-all production total. Most of this was due to beehive operations in the state.

NUMBER AND CAPACITY OF OVENS

There was a total at the end of 1956 of 15,923 by-product ovens which is a decrease of 116 over 16,039 ovens in operation at the beginning of the year. The total annual coke capacity of the smaller number of ovens at the end of the year was slightly lower or 79,965,100 tons compared with 79,675,500 tons the year before. Ovens built in 1956 totaled 302 compared with 565 ovens built in 1955. Capacity of the ovens completed in 1956 was 1,758,200 tons compared with 2,823,600 tons which went into operation the year before. Ovens abandoned in 1956 totaled 418 or one more than the number abandoned in 1955. Under construction at the end of the year was a total of 631

TABLE II

Salient Statistics of the Coke Industry in the United States in 1956

		By-product	Beehive ovens	Total
Coke produced—At merchant plants	net tons	9,575,194	(1)	(1)
At furnace plants	net tons	62,417,048	(1)	(1)
Total	net tons	71,992,242	2,462,022	74,454,264
Screenings or breeze produced	net tons	4,771,813	91,408	4,863,221
Coal charged into ovens	net tons	102,248,733	4,043,383	106,292,116
Average value of coal per ton		$9.35	$5.99	$9.22
Average yield in per cent of total coal charged—				
Coke		70.41	60.89	70.05
Breeze (at plants actually recovering)		4.67	3.66	4.64
Ovens—In existence January 1		16,039	10,104	26,143
In existence December 31		15,923	9,549	25,472
Dismantled during year		418	735(3)	1,153
In course of construction December 31		631	18	649
Annual coke capacity December 31	net tons	79,965,100	5,765,700	85,730,800
Coke used by producer—In blast furnaces	net tons	59,577,960	335,531	59,913,491
In foundries	net tons	251,199	...	251,199
To make producer gas	net tons	172,796	...	172,796
To make water gas	net tons	848,915	...	848,915
For other purposes	net tons	515,258	...	515,258
Coke sold—(Commercial sales)				
For blast furnace use	net tons	4,663,480	1,734,627	6,398,107
For foundry use	net tons	2,659,236	41,341	2,700,577
For manufacture of water gas	net tons	90,113	29	90,142
For other industrial use	net tons	1,676,424	335,596	2,012,020
For domestic use	net tons	905,920	6,516	912,436
Disposal of screenings or breeze—				
Used by producer—For steam	net tons	2,423,147	...	2,423,147
For sintering iron ore	net tons	575,605	16,081	591,686
For other purposes	net tons	441,460	2,089	443,549
Sold	net tons	1,123,658	73,281	1,196,939
Average receipts per ton sold (merchant sales)				
Furnace coke		$15.70	$14.02	$15.24
Foundry coke		$26.50	$16.58	$26.35
Water-gas coke		$17.69	$15.79	$17.69
Other industrial coke		$14.17	$14.31	$14.19
Domestic coke		$16.30	$12.41	$16.27
Screenings or breeze		$ 6.44	$ 2.45	$ 6.19
Stocks on December 31, 1952:				
Furnace coke	net tons	2,014,528	10,431	2,024,959
Foundry coke	net tons	63,067	...	63,067
Domestic and other coke	net tons	244,980	1,435	246,415
Screenings or breeze	net tons	940,902	144	941,046
By-products produced—Tar	gal	832,827,042	...	832,827,042
Ammonium sulphate or equivalent(4)	lb	1,949,604,164	...	1,949,604,164
Gas	M cu ft	1,055,328,682	...	1,055,328,682
Burned in coking process	per cent	35.10	...	35.10
Surplus sold or used	per cent	62.88	...	62.88
Wasted	per cent	2.02	...	2.02
Crude light oil	gal	290,972,209	...	290,972,209
Yield of by-products per ton of coal—				
Tar	gal	8.15	...	8.15
Ammonium sulphate or equivalent(4)	lb	19.28	...	19.28
Gas	M cu ft	10.32	...	10.32
Crude light oil	gal	2.92	...	2.92
Coal used per ton of coke	tons	1.42	1.64	1.42
Value of coke at ovens		$1,274,213,780	$34,849,286	$1,309,063,066
Value of screenings or breeze		$ 26,207,396	$ 234,022	$ 26,441,418
Value of by-products sold—Tar sold and used by producer		$ 91,854,268	...	$ 91,854,268
Ammonia (sulphate and liquor)(4)		$ 32,202,457	...	$ 32,202,457
Gas (surplus)		$ 151,481,650	...	$ 151,481,650
Crude light oil and derivatives		$ 78,995,552	...	$ 78,995,552
Other coal-chemical materials(2)		$ 28,820,352	...	$ 28,820,352
Total value of coke and breeze produced and coal-chemical materials sold and tar used by producer		$1,683,775,455	$35,083,308	$1,718,858,763

(1) Not separately recorded. (2) Naphthalene, tar derivatives, and miscellaneous coal-chemical materials. (3) Includes idle ovens, not expected to go back into production. (4) Includes diammonium phosphate and ammonium thiocyanate.

ovens which will have a planned capacity of 3,309,300 tons. New ovens were completed in five states. The leading increase was in Indiana where 162 ovens were completed with a capacity of 891,200 tons; following this were 50 ovens in Illinois with a capacity of 279,000 tons, 41 ovens in West Virginia with a capacity of 280,000 tons, 30 ovens in Alabama with a capacity of 164,000 tons and 19 ovens in Pennsylvania with a capacity of 144,000 tons. Of the 418 ovens abandoned during the year, 136 were in Illinois, 51 in Ohio, 31 in New York, 7 in Missouri, and 1 in Chicago. Under construction at the end of the year, there were 192 in Pennsylvania with a capacity of 864,900 tons, 186 in Ohio with a capacity of 985,500 tons, 102 in Illinois rated at 579,000 tons, 70 in Michigan rated at 500,000 tons and 73 in Alabama rated at 379,900 tons.

At the end of 1956 there were 9549 beehive ovens with a capacity of 5,765,700 tons compared with 10,104

TABLE III

Summary of Coke-Oven Operations in the United States in 1956, by States

State	Oven coke						
	In existence December 31 (1)		Coal carbonized (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens	
	Plants	Ovens				Total	Per ton
Alabama	7	1,424	7,879,210	73.15	5,763,749	$ 111,219,091	$19.30
California	1	225	1,688,287	61.15	1,032,375	(2)	(2)
Colorado	1	256	1,131,129	66.17	748,440	(2)	(2)
Illinois	7	625	3,938,156	71.16	2,802,223	51,791,553	18.48
Indiana	5	2,165	12,361,784	72.16	8,920,369	186,181,917	20.87
Maryland	1	687	4,198,946	72.65	3,050,420	(2)	(2)
Massachusetts	1	108	852,409	71.33	608,052	(2)	(2)
Michigan	4	691	4,745,766	74.40	3,531,031	67,116,136	19.01
Minnesota	3	241	1,401,792	72.23	1,012,564	19,857,956	19.61
New Jersey	2	341	1,624,316	75.30	1,223,050	(2)	(2)
New York	3	831	5,430,386	70.44	3,825,368	58,552,685	15.31
Ohio	16	2,493	16,773,169	70.34	11,799,045	201,232,720	17.06
Pennsylvania	14	3,976	27,929,111	68.38	19,098,406	316,661,062	16.58
Tennessee	1	44	258,460	79.78	206,196	(2)	(2)
Texas	2	140	874,173	73.88	645,830	(2)	(2)
Utah	2	308	2,101,090	63.54	1,334,976	(2)	(2)
West Virginia	5	813	5,993,141	70.04	4,197,403	60,823,375	14.49
Connecticut, Kentucky, Missouri, and Wisconsin	4	555	3,067,408	71.49	2,192,745	37,881,051	17.28
Undistributed	..	...	...	...	...	162,896,234	18.41
Total 1956	79	15,923	102,248,733	70.41	71,992,242	1,274,213,780	17.70
At merchant plants	22	2,424	13,179,615	72.65	9,575,194	175,633,398	18.34
At furnace plants	57	13,499	89,069,118	70.08	62,417,048	1,098,580,382	17.60
Total 1955	81	16,039	104,873,873	70.16	73,584,214	$1,199,630,173	$16.30

State	Beehive coke						Total	
	Ovens in existence December 31	Coal carbonized (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
					Total	Per ton		
Alabama	...	...	...	...	...	...	5,763,749	$ 111,219,091
California	...	...	...	...	...	...	1,032,375	(2)
Colorado	...	...	...	...	...	...	748,440	(2)
Illinois	...	...	...	...	...	...	2,802,223	51,791,553
Indiana	...	...	...	...	...	...	8,920,369	186,181,917
Maryland	...	...	...	...	...	...	3,050,420	(2)
Massachusetts	...	...	...	...	...	...	608,052	(2)
Michigan	...	...	...	...	...	...	3,531,031	67,116,136
Minnesota	...	...	...	...	...	...	1,012,564	19,857,956
New Jersey	...	...	...	...	...	...	1,223,050	(2)
New York	...	...	...	...	...	...	3,825,368	58,552,685
Ohio	...	...	...	...	...	...	11,799,045	201,232,720
Pennsylvania	7,873	3,202,726	62.62	2,005,590	$27,713,371	$13.82	21,103,996	344,374,433
Tennessee	...	...	...	...	...	...	206,196	(2)
Texas	...	...	...	...	...	...	645,830	(2)
Utah	297	222,844	50.60	112,755	(2)	(2)	1,447,731	(2)
Virginia	483	319,110	52.01	165,968	2,555,797	15.40	165,968	2,555,797
West Virginia	703	170,123	61.39	104,440	1,476,830	14.14	4,301,843	62,300,205
Connecticut, Kentucky, Missouri and Wisconsin	193	128,580	56.98	73.269	(2)	(2)	2,266,014	(2)
Undistributed	...	...	...	...	3,103,288	16.68	...	203,880,573
Total 1956	9,549	4,043,383	60.89	2,462,022	34,849,286	14.15	74,454,264	1,309,063,066
Total 1955	10,104	2,869,212	59.86	1,717,612	$22,231,455	$12.94	75,301,826	$1,221,861,628

(1) Excludes plants retired permanently during year. (2) Included with "Undistributed" to avoid disclosure of individual company figures.

ovens with a capacity of 6,285,300 tons the year before. Of these 7456 with a capacity of 4,551,600 tons were in operating condition compared with 8790 ovens with a capacity of 5,516,700 tons in operating condition the year before. The drop in capacity is continuing the trend going on over the past few years. Some 735 ovens (all but two in Pennsylvania) were abandoned in 1956, a much smaller number than the 2665 abandoned in 1955. In 1956, 180 ovens were rebuilt and eighteen were under construction at the end of the year. All ovens rebuilt and those in the course of construction were located in Pennsylvania. Of the ovens in Pennsylvania 6146 with a capacity of 3,945,400 tons were in operating condition. Thus, Pennsylvania has about 86 per cent of all the beehive capacity in operating condition which is down from 89 per cent in Pennsylvania in the previous year.

The increase in steel capacity has not been reflected in oven construction. Some of this has been undoubtedly due to the lower coke rates which have been accompanying the more efficient blast furnace operation and the increased preparation of the furnace burden.

TABLE IV

Coal-Chemical Materials Produced at Coke-Oven Installations in the United States in 1956(1)
(Exclusive of Breeze)

Product	Produced	Sold			On hand
		Quantity	Value		
			Total	Average	Dec. 31
Tar, crude ..... gal	832,827,042	(2)416,286,387	$ 50,128,897	$ 0.120	33,012,294
Tar derivatives					
Creosote oil					
Distillate as such (100 per cent creosote) ..... gal	23,984,066	25,116,776	4,976,332	0.198	923,592
Creosote-coal tar solution (100 per cent solution basis) .. gal	4,445,213	4,396,725	793,907	0.181	173,790
Creosote content of solution (100 per cent creosote basis) ..... gal	3,711,153	3,637,449	...	...	...
Crude chemical oil ..... gal	26,311,145	26,135,677	6,923,790	0.265	1,142,634
Phenol ..... lb	10,885,176	11,655,269	1,708,187	0.147	234,448
Pitch of tar					
Soft(3) ..... net tons	634,190	31,880	995,267	31.219	16,473
Hard(4) ..... net tons	391,319	57,084	1,500,271	26.282	2,010
Other coal-tar derivatives(5)	...	...	3,146,309	...	...
Ammonia, lb					
Sulphate(6)	1,765,400,190	1,799,497,899	28,447,770	0.016	369,031,678
Liquor (NH_3 content)	35,361,509	32,587,478	1,205,393	0.037	3,014,480
Diammonium phosphate	47,036,678	47,145,260	2,549,294	0.054	12,842,084
Total	...	...	32,202,457	...	...
Sulphate equivalent of all forms	1,949,604,164	1,973,049,987	...	...	...
NH_3 equivalent of all forms	502,583,125	508,626,054	...	...	...
Gas, M cu ft					
Used under boilers, etc.	(7) 1,055,328,682	63,372,938	10,325,566	0.163	...
Used in steel or allied plants		497,279,254	108,006,604	0.217	...
Distributed through city mains		64,302,983	26,284,050	0.409	...
Sold for industrial use		38,640,465	6,865,430	0.178	...
Total	1,055,328,682	663,595,640	151,481,650	0.228	...
Crude light oil ..... gal	(8)290,972,209	14,628,164	3,176,711	0.217	6,206,887
Light-oil derivatives, gal					
Benzene					
Specification grades (1 degree, 2 degree, 90 per cent, and other industrial grades) ..... gal	174,426,023	173,420,085	59,547,670	0.343	6,658,912
Motor grade	(9)	(9)	(9)	...	(9)
Toluene (all grades)	37,238,064	35,583,636	10,161,869	0.286	3,575,549
Xylene (all grades)	10,339,817	10,237,291	3,245,357	0.317	746,905
Solvent naphtha (crude and refined)	5,824,619	5,703,537	1,437,656	0.252	372,716
Other light-oil products	6,400,339	4,872,306	661,824	0.136	310,544
Total	234,228,862	229,816,855	75,054,376	0.327	11,664,626
Intermediate light oil ..... gal	3,007,973	3,046,736	764,465	0.251	194,279
Naphthalene (crude)					
Solidifying under 74 C ..... lb	34,472,210	32,428,387	1,236,402	0.038	2,521,888
From 74 to 79 C ..... lb	142,786,672	103,500,476	7,035,576	0.068	31,140,920
Sodium phenolate ..... gal	3,691,506	3,506,022	425,256	0.121	382,586
Sulphur ..... lb	6,395,070	6,270,170	79,055	0.013	801,590
Value of all coal-chemical materials sold	...	...	$341,628,908	...	...

(1) Includes products of tar distillation conducted by coke-oven operators under same corporate name. (2) Includes 38,898,052 gallons sold to affiliated companies for refining. (3) Water-softening point, less than 110 F. Includes some medium pitch-of-tar reported by two producers. (4) Water-softening point, over 160 F. (5) Cresols, cresylic acid, pitch coke, pyridine, red oil, road tar, tar paint and refined tar. (6) Includes ammonium thiocyanate. (7) Includes gas used for heating ovens and gas wasted. (8) 276,765,214 gallons refined by coke-oven operators to make derived products shown. (9) Included with "Other light-oil products" to avoid disclosure of individual company figures.

COAL CHARGED INTO COKE OVENS

In 1956 coal charged into coke ovens totaled 106,292,-116 tons. Of this 102,248,733 tons with a value of $955,878,806 were charged into by-product ovens and 4,043,383 tons valued at $24,226,023 were charged into beehive ovens. The average value per ton of coal charged into the by-product ovens was $9.35 and that into the beehive ovens was $5.99. These prices are appreciably higher than the coal cost in 1955 when they were $8.84 per ton for the slot-type ovens and $5.59 per ton for the beehive ovens. There were some 377,311 tons of anthracite charged into slot-type ovens at an average cost of $8.89 a ton which are included in the previous totals. Anthracite was over $1 higher than the previous year when the cost average $7.85 a ton. The cost of coal which was needed to make one ton of coke in the by-product ovens in 1956 was $13.30 compared with $12.60 in 1956. It took 1.42 tons of coal to make a ton of by-product coke in 1956 which is slightly under the 1.43 tons of coal needed in 1955. It took 1.64 tons of coal to make a ton of beehive coke and the cost of the beehive coke, in terms of coal was therefore $9.85 a ton compared with $9.34 in 1955. It took slightly less coal to make beehive coke in 1956 than 1955 when 1.67 tons were needed.

The leading states in the mining of coking coal for by-product ovens are, in the order of their importance, West Virginia, Pennsylvania, Kentucky and Alabama who produce 39,956,157, 38,907,984, 12,745,261, and 7,598,394 tons respectively or 95.2 per cent of the 104,148,252 tons which were mined.

COKE USAGE AND DISTRIBUTION

Apparent consumption of all coke in the United States in 1956 was 73,295,832 tons compared with 76,145,732 tons in 1955. This figure reflects total production in 1956 of 74,454,264 tons, imports of 130,995 tons, exports of 655,717 tons and an increase in stocks during the year of plus 633,670 tons.

Blast furnaces used 66,311,598 tons (including coke exported) in 1956 or 89.2 per cent of the 74,454,264 tons produced. This is a decrease from the 68,171,966 tons used by blast furnaces in 1955. The cutback was due to the steel strike which resulted in the banking of most blast furnaces. The drop in the coke rate is also reflected in these figures, since only 1719.1 lb of coke were needed per net ton of pig iron and ferroalloys in 1956 compared with 1761.3 lb in 1955. In terms of coke and coal per net ton of pig iron and ferroalloys, the figures are 2452.4 lb of coal in 1956 compared with 2519.7 lb in 1955. Total commercial sales of coke for blast furnace use was 6,398,107 tons compared with 5,849,002 tons in 1955.

Some 2,951,776 tons of coke were delivered to foundries. This is just under four per cent of the total consumed during the year and appreciably less than the 3,253,927 tons consumed in 1955. Coke shipped to producers in water gas plants in 1956 was 172,796 and 939,057 tons respectively for a total of 1,111,853 tons or 1.5 per cent of consumption compared with the 1,232,405 tons or 1.6 per cent of consumption in 1955. Other industrial plants used 2,527,278 tons in 1956 (3.5 per cent of consumption) compared with 2,616,269 tons (3.4 per cent of consumption in 1955). Residential heating coke (912,436 tons or 1.2 per cent) is down from the 1,126,065 tons in 1955 and continues the decline in the amount used for this purpose.

The bulk of the coke produced was used by the basic iron and steel industry who also have the bulk of the coking producing capacity. Coke movement also therefore follows the iron and steel industries and, in general, most coke is used near where it is produced.

Pennsylvania was the largest user of coke with 20,001,640 tons which is only slightly less than the 21,103,996 tons produced in the state. The second largest consumer of coke was Ohio with 13,850,147 tons and Ohio was also the second largest producer with 11,799,045 tons. Ohio is an importer of coke to the tune of about 1,200,000 tons. The third largest user of coke is Indiana with 6,967,179 tons and since it produced some 8,920,369 tons, Indiana is an exporter of coke. Much of this is moved, however, only a short distance to plants over the Illinois line in the Chicago district. Every state in the Union and the District of Columbia used some coke, although only twenty-one states produced coke. Except for areas where iron was made, movements were relatively minor.

STOCKS OF COKE AND COKING COAL

Stocks of coke increased during the year and the available stocks on hand at the end of the year totaled 2,334,441 tons compared with 1,700,771 tons the year before. Stocks of furnace coke at by-product plants totaled 2,014,528 tons, foundry coke at by-product plants totaled 244,980 tons. Stocks at beehive plants were minor totaling 12,010 tons, including 10,431 tons of blast furnace coke and 1,435 tons of domestic and other coke. At the end of the year, stocks of coke breeze at by-product plants totaled 940,902 tons with an additional 144 tons at beehive plants to give a total of 941,046 tons and under the 759,290 tons at the end of 1955.

GROSS VALUE IN YIELD OF BY-PRODUCTS

Total gross value of by-products which were sold in 1956 was $341,628,908 which is two per cent less than the $348,379,639 which was sold in 1955. The gross value of the by-products was therefore 26.7 per cent of $1,274,213,780, the value of the coke produced at by-product plants during the year. An average of $23.38 per ton of by-product coke produced was realized from coke, coke breeze and coke chemical materials. This includes $17.70 for the coke, $0.35 for the breeze and $5.33 for the coke chemical materials. Coal cost per ton of by-product coke was $13.30 a ton compared with $12.60 a ton in 1955, and coal cost per ton of beehive coke was $9.85 a ton compared with $9.34 a ton in 1955.

In general yields for the primary coke by-products in 1956 were quite close to those in 1955. Compared with 1955, tar yield increased from 8.13 to 8.15 gal per ton of coal, ammonium sulphate or equivalent dropped from 20.06 to 19.28 lb, crude light oil remained practically the same going from 2.91 to 2.92 gal, and the surplus gas sold or used dropped slightly from 6.58 to 6.49 M cu ft per ton of coal.

D-C MILL MOTOR BRAKE STANDARD

AISE STANDARD NO. 11

Adopted September, 1952

Revised September, 1957

Published by

Association of Iron and Steel Engineers

1010 Empire Building

Pittsburgh 22, Pa.

1. General

a. The development of the AISE 600 series mill motor for frames No. 2, 602, 603, 604, 606, 608, 610, 612, 614, 616, and 618, which is covered by AISE Standard No. 1, made desirable revisions in the design of the brakes used for such motors, and AISE Standard No. 11 was adopted in September, 1952 for this purpose.

b. The addition of three additional frames, No. 620, 622, and 624, to AISE Standard No. 1 in 1957 has necessitated revising AISE Standard No. 11 to include brakes for these additional frames.

c. This d-c mill motor brake standard has been developed by a combined AISE-NEMA group. Brakes for motor frames, No. 2, 602, 603, 604, 606, 608, 610, 612, 614, 616, and 618, covered by AISE Standard No. 1 "D-C Mill Motor Standards," have been previously approved by NEMA and also issued as "Torque Ratings and Dimensions of D-C Operated Brakes for the 600 Series of Mill Motors"—IC 1-20.13. Additional brakes described in Table I for frames No. 620, 622, and 624 will be added to this NEMA standard contingent upon approval by the necessary NEMA groups.

d. The objective is to standardize d-c mill motor brakes for AISE 600 series motors so that all manufacturers brakes are interchangeable with respect to mounting dimensions, torque ratings and wheel dimensions.

e. All brakes must be designed so that they can be applied to the AISE standard d-c mill motors in such a way that the height from the center line of the wheel to the base of the brake shall be at least $\frac{1}{8}$ in. less than the height from the center line of the shaft to the base of the motor. Thus no well will be required to mount the brake.

f. Brake standards covering frames No. 2, 602, 603, 604, 606, 608, 610, 612, 614, 616, and 618 are classified as a permanent standard. Brake standards covering frames 620, 622 and 624 are tentative for one year, at the end of which period they will be reviewed for adoption as a final standard with or without revision.

2. Design

a. Unit stresses are not to exceed those in existing brakes.

b. As far as possible, the design of the brakes is to be such that they can be used on previous series of AISE d-c mill motors.

3. Ratings

a. Brake ratings will be in accordance with those given in Table I. Ratings are given for $\frac{1}{2}$-hr series and 1-hr shunt, 1-hr series and 8-hr shunt.

4. Dimensions

a. Wheel and mounting dimensions are given in Table I.

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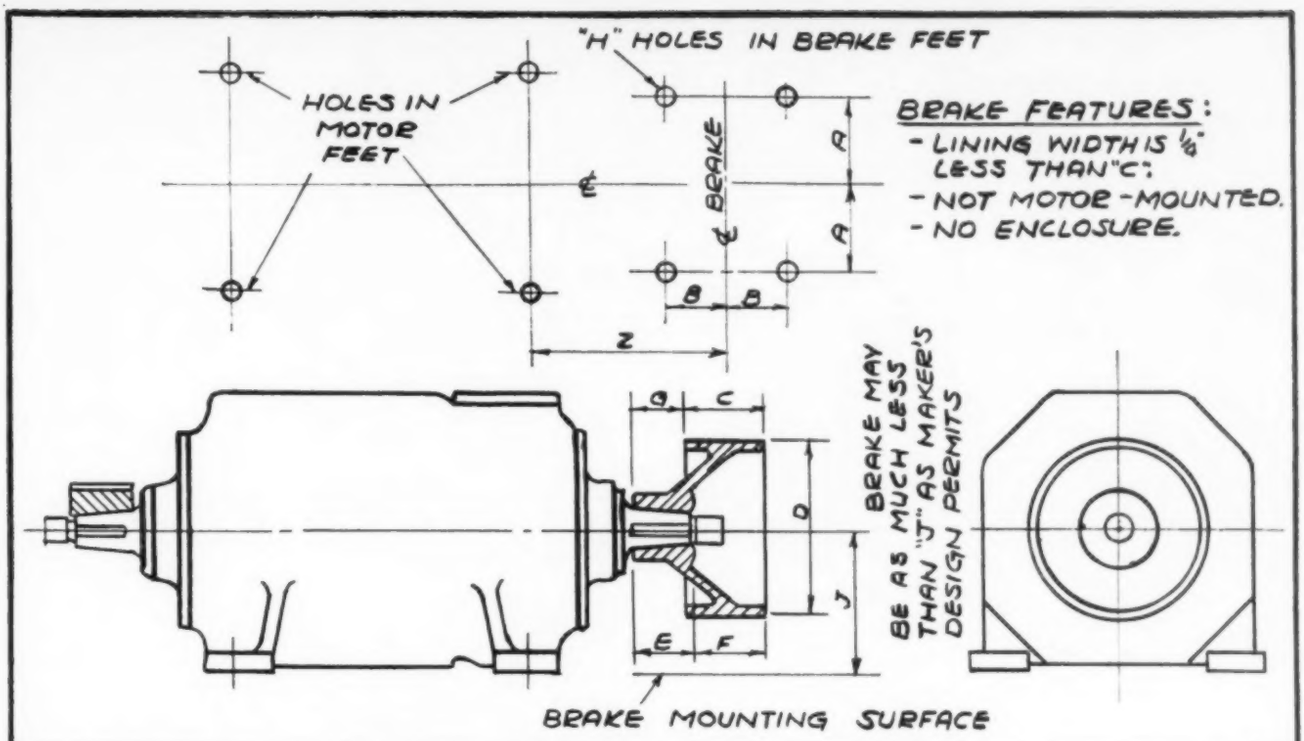


MOTOR	SERIES MOTOR TORQUE LB-FT		BRAKE RATING LB-FT			MOUNTING DIMENSIONS					WHEEL					
	.5 HR	1 HR	4 HR SERIES 1 HR SHUNT	1 HR SERIES	8 HR SHUNT	A	B	H	Z	J	D	C	E	F	G	
2	46	29	100	65	75	3 1/4	2 7/8	11/16	8 1/8	7	8	5 1/4	3	2 5/8	2 3/8	COVERED BY PRESENT STDS.
602	78	49														
603	116	72	200	130	150	4	3 1/8	11/16	9 1/4	8 3/8	10	3 3/4	3 1/2	2 5/8	2 3/8	
604	166	121							9 3/4							
606	337	228	550	365	400	5 3/4	4 1/2	13/16	10 1/2	9 7/8	13	5 3/4	4	3 7/8	2 1/8	
608	502	330							11				4 1/2	3 3/4	2 1/2	
610	765	525	1000	650	750	7 1/2	5 3/8	1 1/16	12 3/4	12 1/8	16	6 3/8	4 1/2	5 3/8	3 1/8	
612	1220	830	2000	1300	1500	9 1/4	6 1/2	1 1/16	14 1/4	13 1/4	19	8 3/4	5	6 7/8	3 1/8	
614	1780	1140							15 1/4							
616	2625	1750	4000	2600	3000	11 3/4	8	1 5/16	17 1/4	15 7/8	23	11 1/4	5 1/2	8 3/8	2 5/8	
618	3615	2560											6		3 1/8	
620	5550	3900	9000	6000	‡	15	9 1/2	1 9/16	18 3/4	20 3/4	30	14 1/4	6 3/4	10 5/8	3 1/8	NEW TENTATIVE
622	8460	5790	9000	6000	‡	15	9 1/2	1 9/16	18 1/2	20 3/4	30	14 1/4	7 1/4	10 5/8	3 5/8	
624	11800	8210	9000 △	△	‡	15	9 1/2	1 9/16	19 1/4	20 3/4	30	14 1/4	9 1/4	8 5/8	3 5/8	

‡ NO 8 HR. RATING ESTABLISHED BY MANUFACTURERS.
△ APPLIES ONLY TO 1 HR. SHUNT BRAKES.

Table I—AISE D-C Mill Motor Brake Ratings and Dimensions

Cameron, Brandt and Kuka Win AISE Paper Awards

▲ WINNERS of the AISE Kelly Award for the best 1956 papers were announced at the 1957 Annual Convention of the AISE in Pittsburgh. First place went to A. M. Cameron, superintendent, blooming and bar mills, Atlas Steels, Ltd., Welland, Ont., Canada, for his paper "Basic Formulas for Roll Design and Rolling of Alloy Steels."

This paper provides a basic manual for the rolling mill operators producing alloy products. It gives practical data which summarizes much experience. The paper was originally published in the June, 1956, *Iron and Steel Engineer*.

Second place winner was Dr. Allen D. Brandt, chief industrial hygiene engineer, Bethlehem Steel Co., Bethlehem, Pa., with his paper "Are You Getting Good Returns from Your Ventilating Investment?" First published in the September, 1956, *Iron and Steel Engineer*, this paper discusses ventilating problems and the evaluation of fundamental principles and premises, so essential if trouble is to be avoided and if the equipment is to operate satisfactorily.

Third place award flew overseas to K. S. Kuka, superintendent, electrical engineering and construction, Tata Iron and Steel Co., Ltd., Jamshedpur, Bihar, India. This paper, first published in the July, 1956, *Iron and Steel Engineer*, is entitled "Short Circuit Protection of Low Voltage Motors and Starters" and points out how careful planning of low voltage power supply in modern steel plants is fully as important as planning the high tension distribution from the standpoint of minimizing short circuit power in the system. By properly locating the modern load center unit substations, it is possible to reduce transformer size. Mr. Kuka, who has written many papers, has received honorable mention for the Kelly Award in several prior years. This is the first time that a winner has come from outside the North American continent. Mr. Kuka also had another paper last year which appeared in the February, 1956, *Iron and Steel Engineer*, entitled "A Stabilized D-C Crane Hoist Control."

Other papers which received honorable mention included one by Eugene Whitaker, chief mechanical engineer, Granite City Steel Co., Granite City, Ill., on "Increasing Capacity of Ladle Cranes," which appeared in the September, 1956, issue of the *Iron and Steel Engineer*. John H. Sprague, who is fuel and utilities engineer, Steel Division, Ford Motor Co., Dearborn, Mich., received an honorable mention for his paper on "New Annealing Facilities for Ford Motor Co.'s Steel Division." This paper appeared in the February, 1956, *Iron and Steel Engineer*.

The Kelly award carries prizes of $300, $200 and $100 for first, second and third place, respectively. The award was established in 1943 to honor John F. Kelly, managing director of the AISE from 1917 to 1934, and to perpetuate the memory of his achievements in the advancement of the Association.

The award is made each year by the board of directors of AISE upon the recommendations of the editorial and executive committees of the Association.

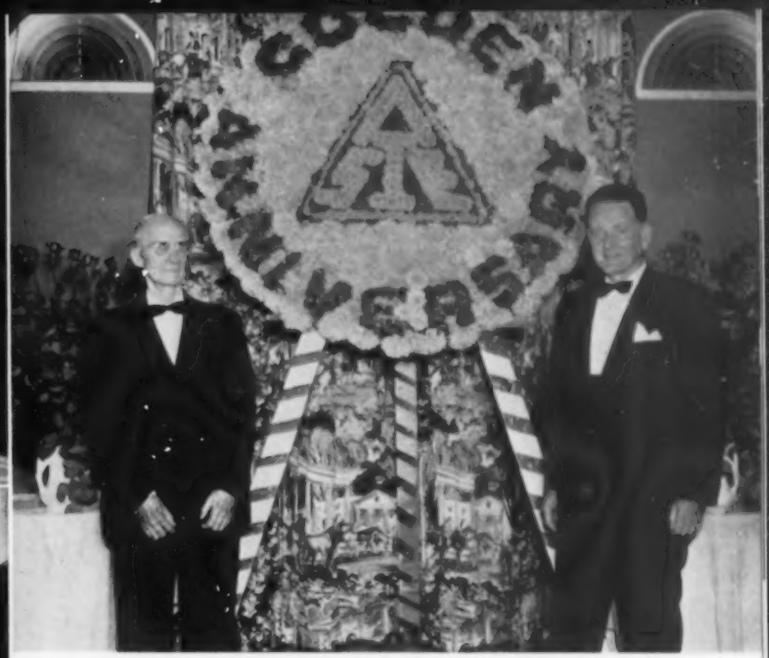
Rules of the award:

1. The award shall be given annually to the author of the paper adjudged of greatest value in the advancement of engineering or operating practice in the iron and steel industry.
2. The entries for each judging shall be the papers published in the *Iron and Steel Engineer* during each calendar year, although some may have been presented at meetings in the previous year.

Voluntary contributions of papers not presented at meetings but published by the AISE are also included in the judging.

3. To be eligible for the award, the author must be directly employed in the iron and steel producing industry. The author need not be a member of the Association of Iron and Steel Engineers.
4. The award shall be made at the annual fall meeting following the close of the calendar year.
5. The award shall be made by the board of directors of AISE on the recommendation of the executive committee of AISE.

AISE President J. D. O'Roark presents Kelly Award certificates to Dr. A. D. Brandt (center), and A. M. Cameron (right), at the Annual Convention. The third winner, K. S. Kuka, was not present for the ceremony.



The first and fiftieth presidents of AISE pose before a floral display depicting the Association's golden anniversary. At left, James Farrington and right, J. D. O'Roark.

Pictorial Review

AISE Annual Convention

Penn-Sheraton Hotel

Pittsburgh, Pa.

September 23, 24, 25, 26

More than 3300 registrants attended the AISE annual convention which also marked the Association's 50th anniversary.

Members of the first combustion session are shown in (1). Seated are E. T. W. Bailey, F. C. McGough, and F. B. Bevelheimer. Standing are A. L. Hodge and G. W. Hinds. The opening operating practice session included (2) G. I. Bottcher, W. T. Hogan, S.J., and S. O. Evans (seated). Standing are: H. E. Skelley, E. T. Culver, and J. S. Joseph.

Attendance at the various sessions was heavy as indicated in (3) and (4).

➡

Pictorial Review

(*continued*)

AISE ladies were entertained by a varied program. Shown in (5) are a group headed for the luncheon held at the Longue Vue Club.

Shown at the Old Timers party are (6) left to right, G. W. Baumgarten, Linn Morrow, and L. F. Coffin.

Members of the rolling mill session (7) discuss their program. Seated are George Breza, A. M. Cameron, and William Rodder. Standing are R. C. Schaefer, R. A. Smith, and A. D. Patton. Final preparations for the operating practice session (8) are made by (seated) Joseph Malborn, R. W. Holman, and P. G. Roldan. Standing are Emil Kern and E. T. Warren. Florentino Moral is shown (9) taking part in a discussion on the Mexican steel industry. Lubrication session members as shown in (10) are (seated) A. E. Cichelli and W. T. Saveland, Jr. Standing are Samuel Carson and W. T. Yarhouse. Shown in (11) are members of the electrical session: R. G. Nolan, R. T. Winterringer, S. P. Curtis, H. G. Frostick, and W. E. Schwabe. In (12) are members of the combustion session: left to right, R. W. Worley, Robert Kyle, Steve Stasko, G. H. Krapf, F. R. Pullen, and H. G. Kitt.

Mechanical session members discuss their program (13) Seated are Richard R. Audette, L. H. Fugassi, and Ross Nebolsine. Standing are R. M. L. Russell, H. R. Knust, and R. D. Lemmerman. Shown in (14) are electrical session members: P. R. Gravenstreter, C. L. Squier, A. J. Mosso, and J. H. Greiner. The oxygen panel session is shown in (15); they are left to right R. A. Lambert, J. H. Strassburger, N. R. Kirkdoffer, A. Stutzer, G. T. Wright, and C. J. Schilling.

At the reception (16) preceding the banquet are E. J. Hanley, president of Allegheny Ludlum Steel Corp., Leonard Larson, first vice president of AISE, and E. O. Burgham, president of Weirton Steel Co. Also at the reception (17) were T. S. Fitch, president of Washington Steel Corp. and J. L. Young, vice president, engineering, U. S. Steel Corp. Also (in 18) are shown, Frank Rackley, president of Jessop Steel Co., and Emil Kern, second vice president of AISE. Shown in (19) are Fred Woodhull, and James Farrington, the only two living charter members of the Association. Shown in (20) is a portion of the more than 1600 people attending the formal banquet.

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CURRENT AISE DISTRICT SECTION MEETING NOTICES

BIRMINGHAM SECTION

Monday, November 25, 1957—Dinner 6:30 P.M., Meeting 8:00 P.M.

"What's New in Steel Mill Cranes," by R. J. Harry, vice president in charge of sales, Alliance Machine Co., Alliance, Ohio

Thomas Jefferson Hotel, Birmingham, Ala.

BUFFALO SECTION

Tuesday, November 12, 1957—Dinner 7:00 P.M., Meeting 8:00 P.M.

Golden Anniversary Celebration

Keynote speaker: H. L. Allen, Jr., assistant vice president in charge of operations, Republic Steel Corp., Cleveland, Ohio

"History and Outlook of AISE," by James D. O'Roark, national president of AISE, assistant manager, department of service and maintenance, electric, Weirton Steel Co., Div. of National Steel Corp., Weirton, W. Va.

Talk by G. W. Gleasner, Buffalo Chamber of Commerce.
Main Ballroom, Hotel Statler, Buffalo, N. Y.

CHICAGO SECTION

Tuesday, November 5, 1957—Dinner 6:30 P.M., Meeting 7:30 P.M.
Golden Anniversary Celebration

"Training Engineers for Industry," by Dr. John T. Rettaliata, president, Illinois Institute of Technology, Chicago, Ill.

South Shore Country Club, Chicago, Ill.

CLEVELAND SECTION

Tuesday, November 19, 1957—Inspection Trip 2:00 P.M., Dinner 6:30 P.M., Meeting 8:00 P.M.

Inspection Trip: Lorain Works, National Tube Div., United States Steel Corp., Lorain, Ohio

"Stretch Reducing Tubes Give Greater Production and Economy," by William Rodder, first vice president, The Aetna-Standard Engineering Co., Pittsburgh, Pa.

Dinner and Meeting, Spring Valley Country Club, Elyria, Ohio

DETROIT SECTION

Tuesday, November 12, 1957—Dinner 6:30 P.M., Meeting 8:00 P.M.

"Oxygen for Steelmaking," by W. B. Farnsworth, Jr., manager, gas process development, Linde Co., Div. of Union Carbide Corp., Newark, N. J.

Engineering Society Building, Detroit, Mich.

LOS ANGELES SECTION

Monday, November 11, 1957—6:30 P.M.

"Knowing's Not Enough," by F. H. Kobely, manager, safety and Casualty, Columbia-Geneva Steel Div., United States Steel Corp., San Francisco, Calif.

Michaels Restaurant, Telegraph and Washington, Los Angeles, Calif.

PHILADELPHIA SECTION

Saturday, November 2, 1957—Dinner 6:00 P.M., Meeting 7:00 P.M.

Golden Anniversary Celebration

"Progress-Past and Future," by C. L. Huston, Jr., president, Lukens Steel Co., Coatesville, Pa.
"A Review of European Steel Plant Progress—1957," by R. C. McMichael, assistant to manager of steel plants, Lukens Steel Co., Coatesville, Pa.

Engineers' Club, 1317 Spruce Street, Philadelphia, Pa.

PITTSBURGH SECTION

Monday, November 18, 1957—Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.
Old Timers Night

Moderator: Ralph H. Wright. *Nostalgic* reminiscing on the early days of electrification of the steel industry.

University Club, University Place, Pittsburgh, Pa.

ST. LOUIS SECTION

Wednesday, November 20, 1957—Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"Centralized Lubrication"

Elks Club, Granite City, Ill.

SAN FRANCISCO SECTION

Tuesday, November 19, 1957—Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

Bethlehem Pacific Coast Steel Corp. Night

"Carbon Black in Fuel Oil for Open Hearth Furnaces," by G. W. Teskey, open hearth superintendent, Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.

Shattuck Hotel, Durant and Shattuck Streets, Berkeley, Calif.

UTAH SECTION

Monday, November 11, 1957—Social Hour 6:30 P.M., Dinner 7:30 P.M., Meeting 8:30 P.M.

"Western Market Outlook," by R. W. Seely, vice president in charge of sales, Columbia-Geneva Steel Div., United States Steel Corp., San Francisco, Calif.

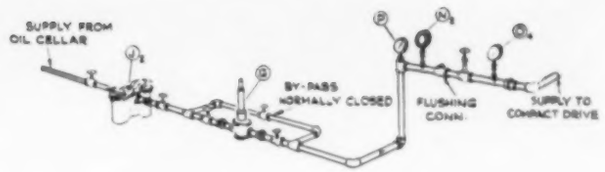
Skyliner Cafe, Provo, Utah

YOUNGSTOWN SECTION

Monday, November 25, 1957—Social Hour 6:30 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"The Effect of New Materials on Steel"

Mahoning Country Club, Youngstown, Ohio



TYPICAL PRESSURE REDUCING STATION

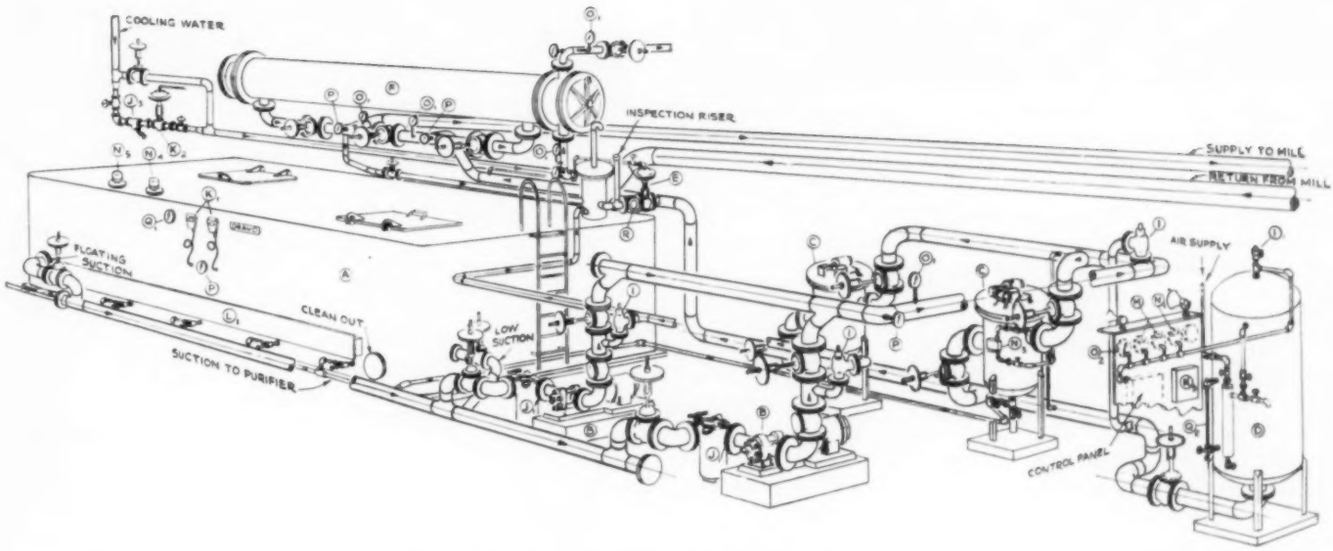


Figure 1 — Schematic sketch of lubrication system for Atlantic Steel Co.'s new merchant and bar mill.

New Merchant and Bar Mill Has Improved Lubrication System

▲ TREMENDOUS pressures and resultant heat generation on gears and drives of a high speed steel rolling mill demand continuous flow of proper lubricants under close temperature and pressure controls.

To meet this demand, three special-built mill lubrication systems feed approximately 475 gpm of extreme pressure oil of various viscosities to gears and bearings on drives of a new merchant bar and rod mill of the Atlantic Steel Co. at Atlanta, Ga.

Recently placed in operation, the $9,000,000-mill is rated as one of the fastest combination units in the world. It is capable of producing three strands of rods simultaneously at a delivery speed of 5000 fpm, and can produce merchant bar in a wide range of sizes and shapes at rates from 30 to 80 tons per hr.

Billets ranging in sizes from 2½-in. squares through 7 x 3-in. slabs, from 25½ to 31 ft in length, are reduced in size to products ranging from No. 5 wire rod (0.218 in.) through 4-in. angles or equivalent cross sections. Billets leave the furnace and enter the roughing mill at approximately 25 fpm.

A feature of the mill is the regulation of all lubrication by 327 built-in orifices which assure distribution of lubricant in proper quantities to the numerous points of use and also eliminates the need for external sight feeds. Of this total, 258 orifices supply oil to individual bearings and 69 supply sprays at gear mesh points.

The lubrication systems, including design of cellar and piping layouts, were supplied by Dravo Corp.,

Figure 2 — Drive gears and bearings on this new combination merchant bar and rod mill of the Atlantic Steel Co. at Atlanta are lubricated by special-built oil circulating systems. A feature of the mill is regulation of all lubrication by built-in orifices, which assure distribution of lubricant in proper quantities to the numerous points of use.

Figure 3 — A large signal panel mounted above the mill floor directly opposite the mill pulpit provides immediate notice by means of lights and audible alarms of an oil pressure failure in the lubrication system. Controlled by low pressure switches at each lubrication point, the signals enable personnel to pinpoint the nature and exact location of trouble.

Pittsburgh, in accordance with detailed engineering specifications of Morgan Construction Co., Worcester, Mass., who designed and built the mill machinery.

The smaller of the three lubrication systems supplies 22 gpm of 1000 SSU oil at 100 F to gear drives which operate the billet cross pushers for the gas-fired reheating furnace. Gears for these drives are enclosed in two separate housings with their sumps serving as reservoirs for the lubricating oil supply. Oil returning to the pump from the reservoirs passes through the pump suction strainer. After being brought back to the desired pressure, the oil then passes through the main system filter to remove any foreign particles before returning to the drives.

Pressure and temperature are both indicated in the smaller system by instruments on the drive platform and signal lamps at the charging pulpit of the furnace provide operating personnel a visual indication that the system is operating and that proper lubrication is being maintained.

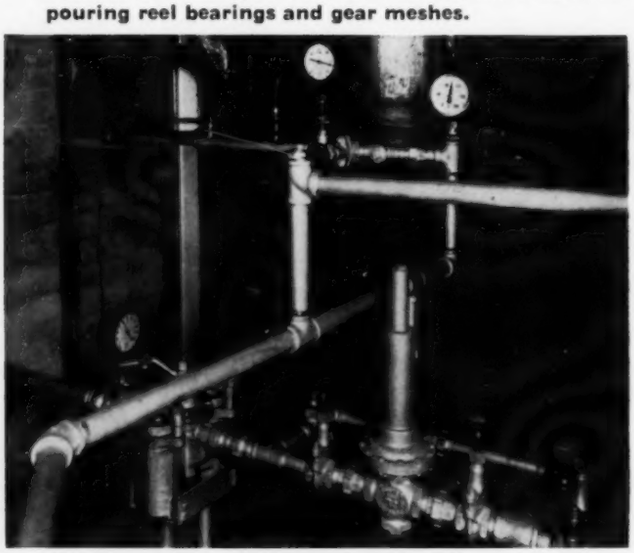
Two larger lubrication systems supply oil to the main gear drives, pinions, and auxiliary equipment. The mill has 21 roll stands, 15 of which are used when rolling merchant bar sections and all 21 stands are required for smaller diameter wire rod production.

One of the larger systems supplies 230 gpm of 1500 SSU oil at 100 F, and serves the pinion stands, speed reducers, drives and pedestal bearings for the roughing and intermediate mill stands.

The other large system, supplying 220 gpm of 800 SSU oil at 100 F, has a 2-branch operational arrangement.

Figure 4 (left) — This partial view of the main oil cellar at Atlantic Steel shows the control panel for one of the main lubrication systems. This panel contains master signals for those on the main signal board mounted on the wall on the mill area. Next to the control board is an automatically and continuously cleaned constant pressure drop type filter which removes foreign particles as small as 0.005 in. from the system.

Figure 5 (right) — One of 14 pressure reducing stations in the Atlantic Steel mill lubrication system. This station controls the pressure of the oil to the orifices for pouring reel bearings and gear meshes.



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Branch C-1 is used when merchant bar is rolled. Branch C-2 is operated in conjunction with Branch C-1 when all 21 stands of the mill are in operation during the rolling of rods.

Branch C-1 lubricates gear reducers, drum shear drive, pedestal bearings, and pinions on stands 8 through 15; while Branch C-2 lubricates pouring reels, coil conveyor and laying reels, and the drives for the rod finishing mill.

Branch C-2 is equipped with an automatic pump system to return oil from low points which do not permit return flow by gravity into the main reservoir. Indicating lamps for this return system are mounted on the main signal panel.

Tied into the two larger systems serving the mill are 14 pressure reducing stations to regulate oil pressure to the various orifices. Constant pressure is so important that pressure switches at each pressure reducing station control signal lights and a warning horn on a large signal panel above the mill floor located directly opposite the main mill pulpit. A siren and lights on the signal panel serve as alarms on the main system pressures and reservoir oil levels.

From the green lights on this signal panel, mill personnel are assured that the lubricating systems are functioning and that all machinery components are being supplied oil at the correct pressure and temperature requirements. Operating conditions of both systems are shown on control panels in the main oil cellar.

The two larger lubricating systems have been designed to provide continuous 100 per cent filtration of the oil and to automatically maintain the required flow capacities, operating temperature, and pressure of the lubricating oil. Each component of the lubricating systems is of heavy duty construction capable of providing long service under continuous operation.

Well designed and manufactured, efficient lubricating systems of this type assure increased production by extending operating life and improving the performance of the equipment.

Automatic Electric Furnace Load Control Pays Off for Allegheny Ludlum

▲ A SAVING of $4750 in demand charges during the first month's operation of a new Leeds & Northrup automatic load control system was reported by Allegheny Ludlum Steel Corp. During this same month, Allegheny consumed 400,000 kwhr more energy, yet their net bill was $3150 less than the previous month—the 400,000 kwhr being an extra "no charge" bonus. Currently the company estimates savings at 20,000 kw (about $30,000) per month.

For electric melting furnaces, Allegheny bought electrical power that peaked to well over 100 megawatts, if unregulated. Their total power bill consisted of a 15-min demand charge (about $1.80 per kva per month) and an energy charge of about $0.004 per kwhr. Analysis of their load control curve showed that substantial savings should result if demand were reduced, and that this could be done without a reduction of steel production.

A load control system was installed to regulate the 15-min demand, rather than the instantaneous kw, as in a normal control application. This control integrates the kwhr excess over the desired demand period and then automatically determines the required load reduction. If load trend indicates that the schedule will be exceeded, the regulator resets controls on the electric furnaces, reducing their load. The control automatically selects the furnace or furnaces which are melting (creating excess demand) without disturbing the furnace under refining operation (contributing only slightly to excess demand).

The control now regulates demand at about 70,000 kw. On a monthly average, peak demands fall within 1500 kw of this desired value. In one month the five peak demands were within 1000 kw of each other, resulting in a real saving in demand charges plus maximum consumption of kw hours.

Figure 1 — Load measurements at Allegheny Ludlum's works at Brackenridge and West Leechburg are transmitted to this centralized control panel which provides the automatic load control and load recordings.

Vacuum Stream Degassing Is New Tool for Steel Plant Engineers

. . . . equipment now in operation demonstrates that vacuum pouring is the most economical and dependable way to reduce and control gaseous inclusions in steel . . . .

By

K. C. TAYLOR, Vacuum Equipment Div., F. J. Stokes Corp., Philadelphia, Pa.

▲ A NEW standard of quality in alloy steel will be gas-free steel from which trapped gases and inclusions have been eliminated. Such steel is more uniform, more reliable, and more workable than steel of the same nominal composition made the conventional way.

Gas-free steel is about to emerge from the laboratory into volume production, thanks to the development of equipment for vacuum stream degassing. This equipment degases the steel during the pouring of the ingot—by directing the stream of molten metal just tapped from the open-hearth or the electric melting furnace into a pre-evacuated vacuum chamber which houses the ingot mold. Hydrogen and other gases in the metal are literally "sucked out" during the pouring, leaving a virtually gas-free steel.

Two Stokes-designed vacuum stream degassing units are now in operation at the plant of a major steel producer. One of them—of 10 to 12 tons capacity—has been in service for the better part of a year, and served as the pilot model for a 250-ton unit which went into production this summer.

From these two Stokes-designed units, and from other operating stream degassing units, clear and definite results have been achieved which lead to the conclusion that the procedure is the most economical and dependable way to control gaseous inclusions in steel. (The technique may also become a significant factor in the production of nonferrous metals, too, particularly copper and aluminum.)

The principal improvements which vacuum stream degassing achieves in the physical properties of steel are:

1. Hydrogen content is reduced to as little as one part per million. The resulting elimination of hydrogen flaking—the failure of worked surfaces to weld together during forging—means the virtually complete elimination of rejects in raw and semi-finished forgings.

2. Ingot segregation is greatly reduced.

3. Oxygen content is reduced by up to 35 per cent.

4. Nitrogen content is reduced by as much as 15 per cent.

5. Ductility of the steel is increased by at least two per cent. This means easier forming, drawing, and machining.

6. Soaking pit time is reduced by as much as 70 per cent, depending on ingot size. This means a sizable saving in process time and a corresponding reduction in inventories.

7. Hysteresis loss in steels for transformer construction is markedly lower.

Principal demand for the higher steel produced by vacuum stream degassing is expected to come from the manufacturers of electric generating equipment—the gigantic alternators and the steam turbines or gas turbines which drive them. Rotors of this equipment whirl at high speeds and temperatures. A failure of any component of the rotor—either the shaft or any one of the discs or turbine blades—is likely to cause a disastrous explosion. Where the risk of such damage is high, manufacturers of this equipment (and their customers) demand absolute assurance of safety. These firms are pressing for better steel for this purpose.

Other highly stressed components, too, can effectively use the superior quality steel—cleaner and more uniform and more machinable—obtained by vacuum degassing. Crankshafts for large diesel engines—either for power plants or for ship propulsion—can be made stronger and more failure-proof from degassed steel. Makers of precision rolls will welcome a material without voids—which often show up

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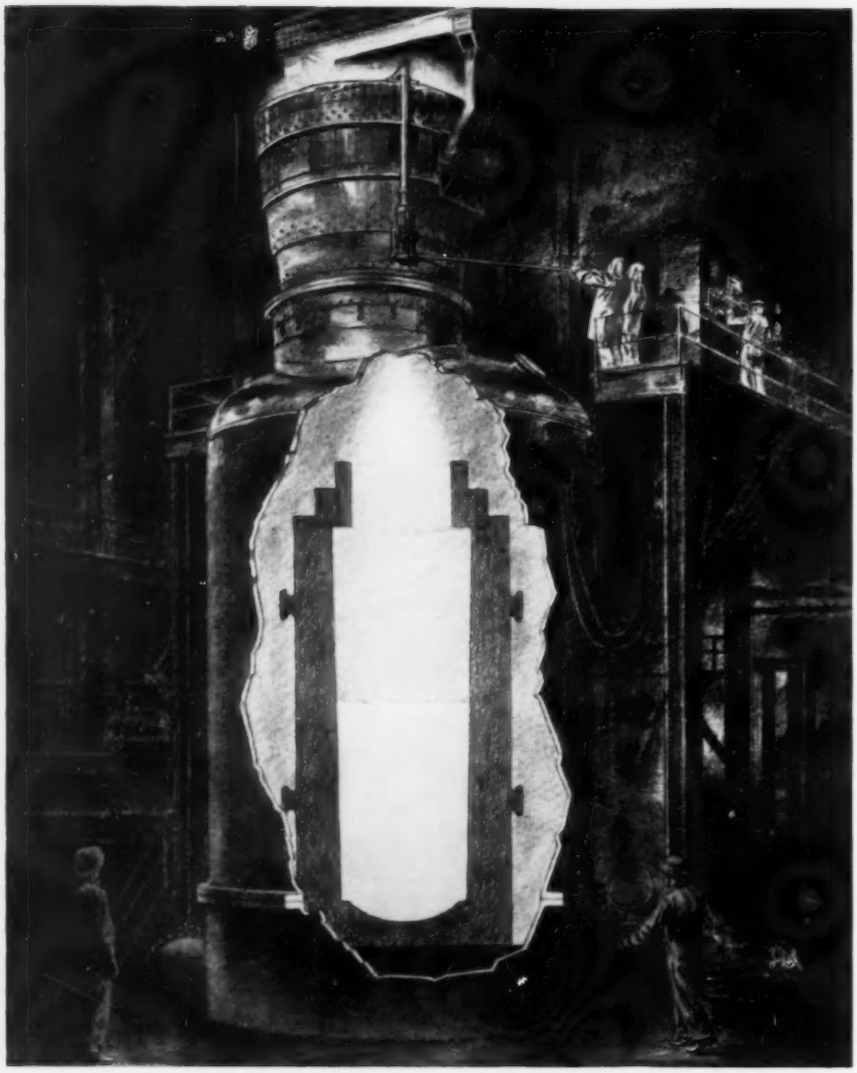


Figure 1 — Artist's rendering shows vacuum stream degassing unit. Two such units are now in operation at the plant of a major steel producer.

only after considerable machining time has been invested. Large forged rings, such as those which go into heavy machine tools and other production equipment, and forging ingots, for heavy ordnance items, are tougher and possess other marked advantages. In the case of forging ingots, degassing can save long annealing heats and other processing time which will more than pay for the cost of the additional equipment needed for degassing.

Even plates and heavy castings can be made better by using degassed steel.

It is estimated that the complete cost for operating and maintaining stream degassing equipment and amortizing the capital outlay—if daily utilization is made—will add only $6 to $9 per ton to the price of steel. This additional cost should be easily recoverable from the savings represented by the superior quality of the steel thus produced. The equipment, therefore, represents a self-amortizing investment.

In stream degassing, as in all vacuum metallurgy, the refinement of the metal takes place by exposing the molten material to the effect of a high vacuum, of the order of 150 microns. Since this refinement is a surface reaction, the greater the exposure of surface area to the vacuum, the greater the degree of refinement. In induction heated vacuum furnaces, or in arc furnace melting, the amount of this exposure is a function of the speed of agitation of the material. In stream-degassing, the amount of surface area exposure depends upon the relative success with which the stream of molten metal is divided into small particles.

In the Stokes-developed process, the molten material is turned into a fine shower or spray of droplets as it passes from the ladle into the vacuum chamber. These particles are of smaller size—hence surface exposure is greater—because the level of vacuum is better than that of other systems used to date.

The steel is tapped from the furnace into a transfer ladle which carries it to the degassing chamber. Here it is poured into an intermediate or "pony" ladle which is kept full from the transfer ladle.

The pony ladle is set on top of a specially shaped receptacle on top of the vacuum chamber, which serves as an ante-chamber in the pouring process.

The vacuum chamber itself has previously been pumped down to high vacuum. An aluminum diaphragm seals the opening to the chamber from the ante-chamber.

When the pony ladle is in place, a by-pass valve to the vacuum pumping system evacuates the ante-chamber.

To start the pour, the stopper rod in the pony ladle is lifted and the hot steel flows through the bottom nozzle. The molten steel stream punctures the aluminum diaphragm and enters the large vacuum chamber. The nearly instantaneous pressure drop causes the molten metal to diffuse spectacularly into a spray of finely divided molten particles. The steel is degassed as it falls through the vacuum chamber and is caught in a conventionally shaped ingot mold beneath the opening. The evacuation system is, of course, kept working continuously during the pour and maintains a vacuum of less than 500 microns, considerably better than the equilibrium pressure of hydrogen in steel.

When the pour is completed, vacuum is broken in the chamber, and the ingot is left to cool.

Stokes, a pioneer in the field of vacuum processing equipment, has built a number of large units for vacuum metallurgy which are successfully in full-scale operation at such plants as Allegheny Ludlum Steel Corp., Watervliet, N. Y.; Utica Drop Forge & Tool Corp.'s Metals Division, Utica, N. Y.; Universal Cyclops Steel Co., Bridgeville, Pa.; International Nickel Co., Bayonne, N. J.; Radio Corporation of America Harrison, N. J.; Cannon-Muskegon Corp., Muskegon, Mich.; Fabricast Division of General Motors Corp., Bedford, Ind., and others.

What happened to the price of oxygen?

The price of bulk oxygen has dropped about 80% in 12 years, while most other prices have risen. Oxygen is now being produced in large quantities for a few pennies per 100 cubic feet.

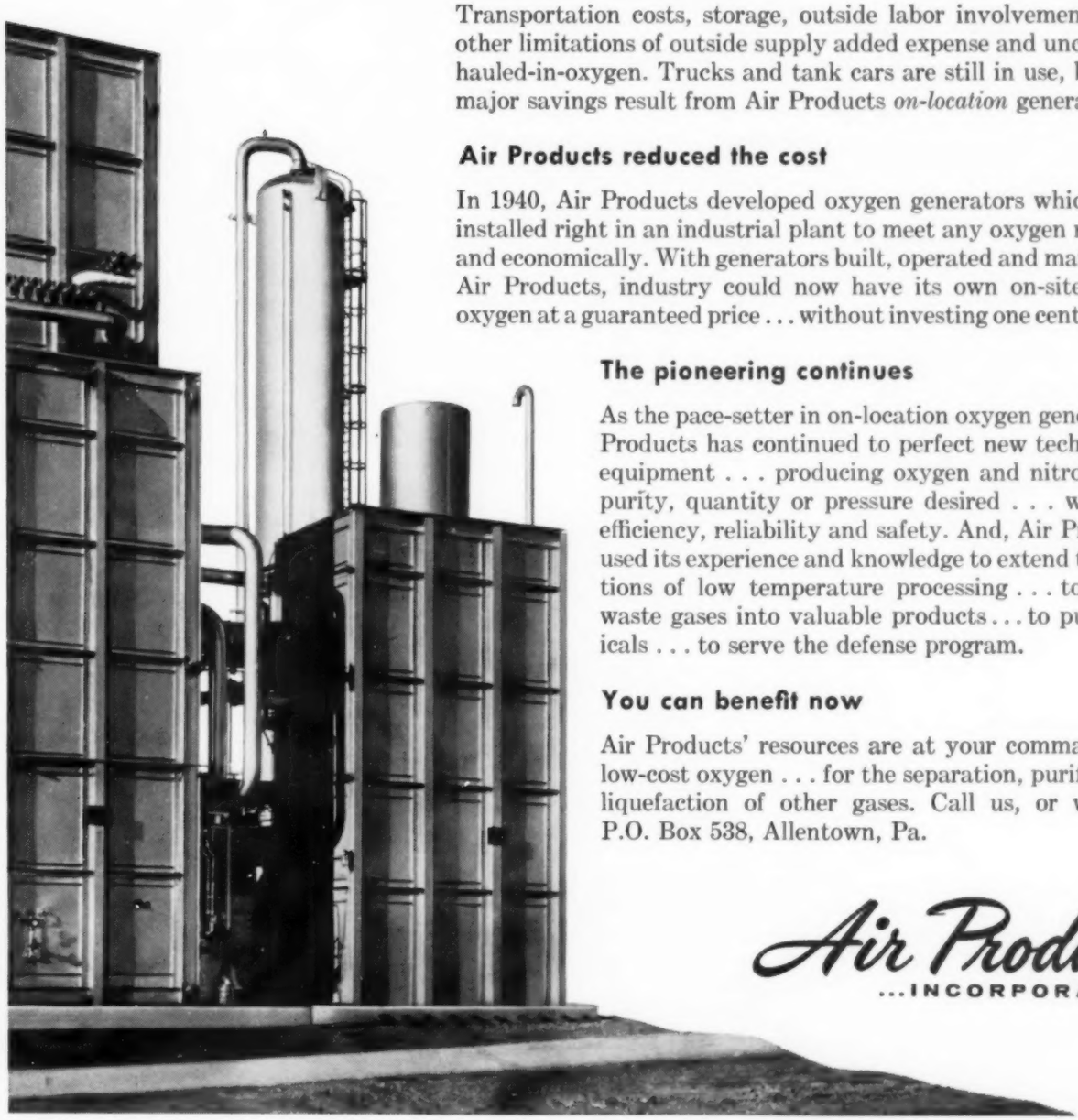
Oxygen isn't the high-priced chemical it used to be. Now, it's a low-priced tonnage commodity—a utility purchased like electricity or water. The price drop is the *real reason* oxygen usage has climbed beyond 70 billion cubic feet per year.

Why was it costly?

Transportation costs, storage, outside labor involvements and the other limitations of outside supply added expense and uncertainty to hauled-in-oxygen. Trucks and tank cars are still in use, but today's major savings result from Air Products *on-location* generation.

Air Products reduced the cost

In 1940, Air Products developed oxygen generators which could be installed right in an industrial plant to meet any oxygen need, safely and economically. With generators built, operated and maintained by Air Products, industry could now have its own on-site supply of oxygen at a guaranteed price . . . without investing one cent of capital.



The pioneering continues

As the pace-setter in on-location oxygen generation, Air Products has continued to perfect new techniques and equipment . . . producing oxygen and nitrogen in any purity, quantity or pressure desired . . . with greater efficiency, reliability and safety. And, Air Products has used its experience and knowledge to extend the applications of low temperature processing . . . to transform waste gases into valuable products . . . to purify chemicals . . . to serve the defense program.

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MULTIPLE STRIP PROCESSING Gains In Popularity

By

E. F. BOENING, Control Dept., Allis-Chalmers Mfg. Co.

▲ TO help keep pace with the increasing demand for stainless steel, a two-strand anneal and pickle line is now being erected in an eastern steel mill. The drive motors and controls incorporating the latest advanced features are being supplied by the Allis-Chalmers Mfg. Co. Although the simultaneous processing of multiple strips of steel is not new, and the economic advantages of such operations have been apparent for some time, the general acceptance of multiple strip processing has been slow because of the operating complexities involved. However, with modern coil handling equipment and new automation control techniques, the operating difficulties are gradually being overcome. A greater demand for multiple strip processing is therefore predicted in the future.

The two-strip anneal and pickle line now being erected has the following basic line specifications:

Material—cold rolled stainless steel strip.

Thickness—0.010-in. minimum; 0.075-in. maximum.

Width—Single strand—20-in. minimum; 52-in. maximum. Double strand—16-in. minimum; 24-in. maximum.

Coil size—20,000-lb maximum weight.

Line speed—Entry section—15 to 300 fpm. Processing section—15 to 150 fpm. Delivery section—15 to 225 fpm.

Two annealing furnaces and three pickling tanks comprise the major processing equipment for the line. If pickling only is desired, provisions have been made for convenient by-passing of the annealing furnaces.

Two methods of strip storage are used to permit continuous movement of the strips through the processing section. At the entry section of the line, a loop car is used to provide horizontal strip storage so that welding, shearing, and coil charging can be done without slowing the line. Free hanging storage loops are used at the delivery end to facilitate coil shearing and stripping.

Variable voltage control is used to control the speed of the line. A single pace setting bridle is used to pull the two strips through the processing section. A magnetic amplifier type speed regulator controls the speed of the strip through the processing section within one-half per cent.

One of the unique features of the line is the single loop car used for strip storage of the two strands at the entry end. The use of a single loop car is possible since the speed of the strips going through the processing section must be exactly the same. An eddy current coupling is used to control the speed of the winch pulling the loop car. Relative movement of the two strips around the single drum of the loop car is possible since a double set of planetary rolls surrounds the drum. Transmission of tension variations from the loop car to the processing section are eliminated by a shallow free hanging loop prior to entry to the furnace.

Both strips in the entry section must be stopped for shearing and welding one of the strips. When the entry section is stopped, the loop car will pay out strip to permit continuous movement of the strip through the processing section. At the delivery end of the line it is not necessary to stop both strands to strip a coil from a reel, since independent speed control of the two delivery sections is provided.

To permit the maximum time for stripping a coil from the reel without slowing down the line, two winding reels are used for each strand. The speed of the delivery sections are independently controlled by step type photo-electric loop regulators. The phototubes for the loop regulators are located in the delivery end loop storage pits.

A feature of the photo-electric step type loop regulators is the proportional speed loop positioning control. With this control, loop position corrections are made at speeds proportional to the speed of the line. For example, if the line is operated at a slow speed, loop positioning will be made at slow speeds. This type of loop regulation permits smoother operation and less mechanical wear on bridles and reels than conventional strip storage loop regulators.

Each reel has a CEMF regulator to compensate for metal buildup. A magnetic amplifier type regulator is used to control tension in the strip.

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ELECTRICITY FROM GAS Is Now Practical

▲THE direct conversion of the chemical energy of gases into electricity—long a dream of scientists and for years a laboratory curiosity—has been accomplished with the development of the first fuel cell capable of economically producing thousands of watts of power. Using hydrogen and oxygen as fuel, the new silent source of power has been developed by scientists at the Research Laboratories of National Carbon Co., Division of Union Carbide Corp.

First significant application of the new fuel cells is in providing silent electrical power for the U. S. Army Signal Corp.'s new "Silent Sentry." The world's smallest known radar set, the light weight, portable unit provides mobile Army forces with local combat surveillance of enemy movements despite smoke, darkness, or fog. A battery of National Carbon Company fuel cells provides power to operate the radar set.

Secret of the new fuel cell's success, is the chemically treated, hollow, porous carbon electrodes through which the gases enter the cell, and which also conduct the electricity produced by the electrochemical reaction.

Designed to work at ambient temperatures, and at approximately atmospheric pressure, the new fuel cell is the first that does not depend on high temperatures or pressures for efficient operation.

The production of electricity directly from hydrogen and oxygen in a fuel cell is inherently more efficient than its production in a conventional steam system in which the heat is supplied by burning these same gases. Practical limitations in utilizing all of the heat produced, reduce the over-all efficiency of a steam system to approximately 30 or 35 per cent, while a fuel cell, which eliminates the intermediate heat step and converts directly from chemical to electrical energy, has a top efficiency of about twice that figure.

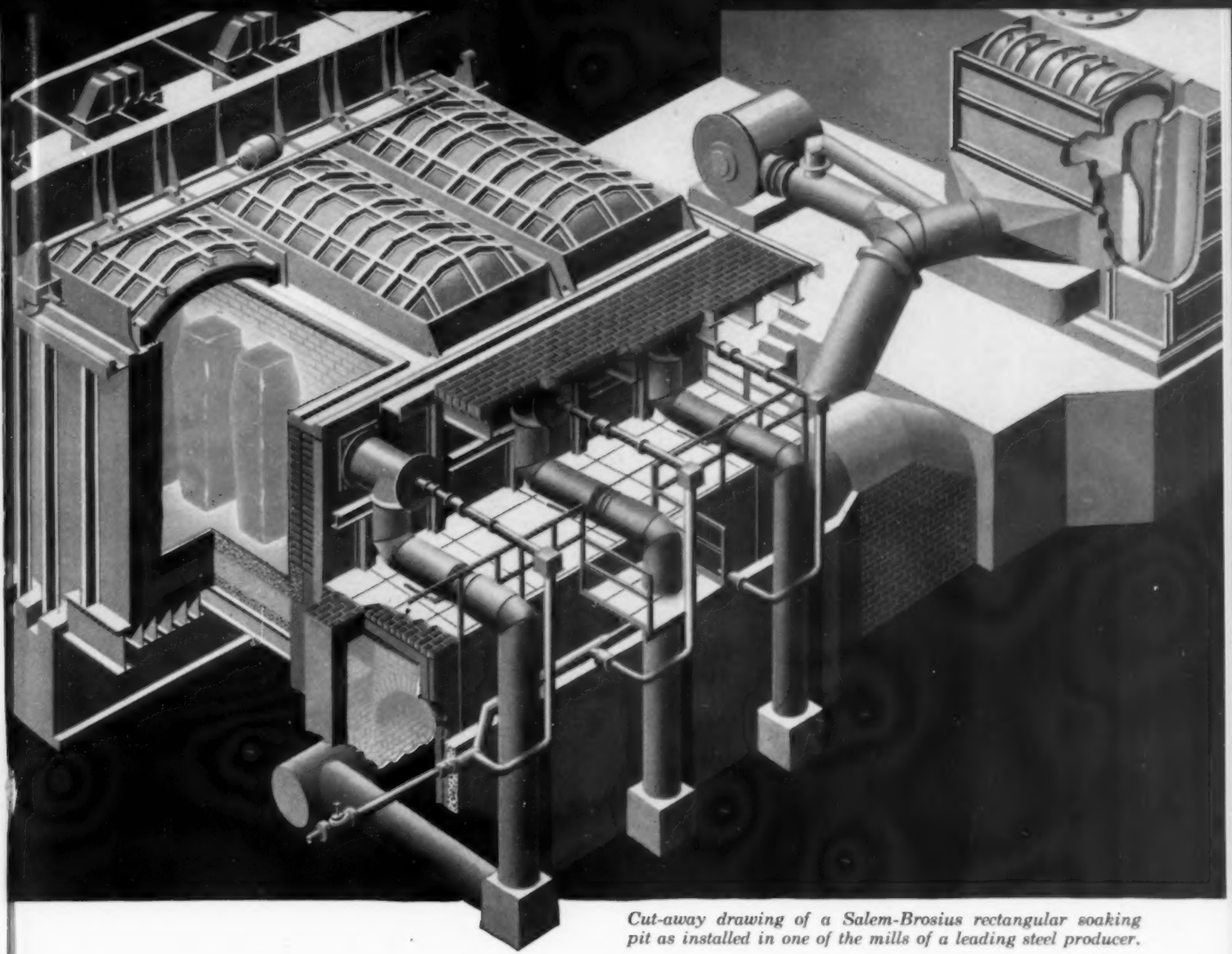
Unlike conventional batteries, fuel cells remain essentially unchanged during their operating life, and produce electrical energy from chemical fuels supplied as needed. A primary battery, such as used in a flashlight, produces electrical energy by the consumption of its chemical elements. When the chemicals are used up, the battery is dead. A secondary battery, such as used in an automobile, can be recharged during its life by passing electricity back into it, where it is stored for future use.

This new fuel cell is merely a sealed jar into which are fed hydrogen and oxygen through the special hollow electrodes. The electrochemical reaction of the gases at these electrodes produces an electric current, with only water as a by-product. With the water disposed of by evaporation, the life of the fuel cell is theoretically unlimited. Cells have been operating eight hours a day, five days a week for the past year, with no signs of deterioration. This type of operation was purposely chosen for testing because the repeated starts and stops are much harder on the cell than would be continuous, around-the-clock operation.

No power plant is 100 per cent efficient, and some of the energy produced is wasted as heat. Operation of the new fuel cell at ambient temperatures results in high efficiency. The new cell's normal operating temperature ranges from 120 to 140 F.

Ability of the new fuel cell to operate at approximately atmospheric pressure has the obvious advantage of eliminating heavy, costly pressure vessels. If increased output is desired, however, it can be obtained by increasing the pressure. For a given cell, higher outputs vary directly with pressure.

The efficiency of operation of the new fuel cell depends on how it is used, but the general efficiency range is from 65 to 80 per cent when operated at normal temperatures and pressures. The fuel cell operates most efficiently when no attempt is made to draw the maximum power from a minimum volume. Efficiency is affected by power density—that is, at lower currents, a greater percentage of the chemical energy is converted to electrical energy. Research and development to date indicate that the optimum fuel cell design will be one which will produce approximately one kilowatt of power from a packaged unit one cubic foot in volume.



Cut-away drawing of a Salem-Brosius rectangular soaking pit as installed in one of the mills of a leading steel producer.

Users are the best salesmen of Salem-Brosius soaking pits

"We have again specified Salem-Brosius rectangular soaking pits for our expansion program," reports an operating official of a major steel company using pits installed by several manufacturers. "The previous installation heated more steel ingots ready for rolling with less fuel consumption, less maintenance cost, and better temperature uniformity than any other type of pit in our plant."

Reports like this are typical, not only about these rectangular soaking pits, but all other Salem-Brosius heating and heat-treating furnaces as well. Salem-Brosius engineers, both here and abroad, possess an enviable record for designing furnaces which produce maximum, high-quality output at minimum operating cost. If your expansion or modernization plans call for ingot soaking pits or any other heating or heat-treating furnaces, Salem-Brosius, Inc. would appreciate an inquiry.

SALEM-BROSIUS, INC.

CARNEGIE, PENNSYLVANIA

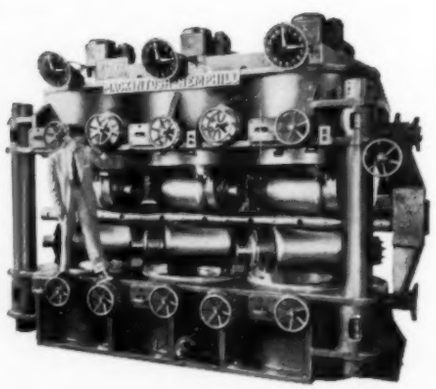
In Canada: Salem Engineering Limited, 1525 Bloor Street West, Toronto, Ontario

...ALL SIZES STRAIGHTENED AND PERFECTLY ROUNDED ON MACK-HEMP ROTARY TUBE STRAIGHTENERS

Tubes of any alloy in any O.D. from .050-inch to 16 inches are production straightened and rounded at speeds up to 800 feet per minute or better. The six driven rolls are fully adjustable to suit tube diameter, amount of straightening bend needed, and correct contact grip on the tube. The machine operates without speed-limiting, surface-marring guides and the finished tubing shows no spiral markings.

All models—from the smallest to the largest—are now available in Mack-Hemp's exclusive new three-post construction.

For complete details of Mack-Hemp straighteners, write today for a free copy of our 24-page Technical Bulletin No. 55-A, "How to Straighten Pipe and Tube".



MACKINTOSH-HEMPHILL Division of E. W. BLISS Company

901 Bingham Street, Pittsburgh 3, Pa.

Makers of the rolls with the Striped Red Wabblers

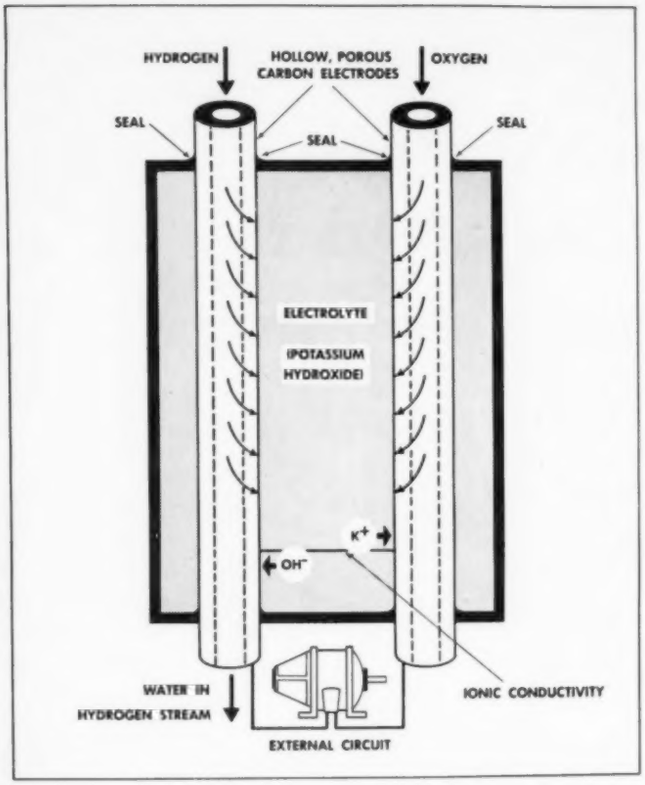


Figure 1 (left) — Simplified drawing illustrates the basic operation of the fuel cell. Hydrogen and oxygen gases enter the cell through specially treated, hollow porous carbon electrodes, and diffuse to the surface, where they come in contact with the electrolyte, a solution of potassium hydroxide. At the hydrogen electrode, the electrochemical reaction releases an electron, which flows through the external circuit and is accepted at the oxygen electrode. This flow of electrons is the current that powers electrical equipment. Ionic conductivity through the electrolyte completes the circuit, and the water formed in the reaction passes from the cell in the hydrogen stream. Figure 2 (right) — This single fuel cell unit consists at present of nine hollow, porous carbon electrodes grouped in a round plastic housing. A carbon header on each end channels the hydrogen and oxygen bases into the proper electrodes, and electrical connections conduct away the power. When in operation, the cell will be filled with a solution of potassium hydroxide, which serves as the electrolyte in the electrochemical reaction.

The voltage across the electrodes of the new fuel cell is approximately one volt, and it is simply a matter of connecting a number of cells in a circuit to get any voltage desired. The amount of electrical current produced by the cell depends on its physical size, so by varying the number and size of cells, many combinations of voltages and currents can be obtained. Basically, the fuel cell is most desirable for high current, low voltage use.

Although pure oxygen is required for higher current densities, the new fuel cell can be operated with hydrogen and air for producing smaller amounts of power. This is particularly advantageous for small. mobile units which can be operated simply on a tank of hydrogen and the surrounding air.

The new design is also unique in that the cell can operate with hydrogen containing considerable impurities, which means that standard industrial grades of commercial purity can be used.

Present designs call for the grouping of a number of specially catalyzed, hollow porous carbon electrodes in a sealed cell containing a solution of potassium hydroxide as the electrolyte. Hydrogen and oxygen enter the cell through the hollow electrodes, and diffuse through the porous carbon to the surface, where they come in contact with the electrolyte. At the hydrogen electrode, the electrochemical reaction with the potassium hydroxide produces water and releases an electron that enters the electrical circuit. The electron flows through the external circuit, and returns to the cell at the oxygen electrode, where in the electrochemical reaction of the oxygen and the electrolyte, the electron is accepted. Ionic conductivity through the electrolyte completes the electrical circuit.

A concentric tube design has also been developed, in which one electrode tube nestles within the other, with the electrolyte in between. The tubes are simply made long enough to give the proper cell volume for the current desired.

The inherent advantages of the fuel cell make it an ideal source of silent electrical power in remote locations where conventional fuels or water power are not available. Military communications systems, mobile power units, and stand-by power plants are but a few of the expected applications.

As a producer of electrical energy, the fuel cell depends on a practical and economical source of hydrogen, a gas that at present is quite expensive and requires relatively bulky pressure vessels. An inexpensive source of hydrogen is a must if the fuel cell is to compete with conventional power systems as they are known today.

"We avoided costly service calls and saved our customers irritating shutdowns ..*by equipping welders we sold with Fusetron Fuses*"....

Frank Korinek, OWNER
SUN RAY ELECTRIC COMPANY
CHICAGO, ILL.

Mr. Korinek continues . . .

"About a year ago my motor rewind shop bought 62 welders for resale from a surplus dealer.

"They were 300 ampere arc welders, with the A.C. motor directly connected to a 300 ampere D.C. generator. The motor has a speed of 3500 R.P.M. and a nameplate rating of 56 amperes at 220 volts.

"The welders were equipped with 60 amp., 250 volt fuse clips. However, when we ran the welders in the shop, we found that ordinary 60 amp. fuses would blow on the starting current of the motor.

"We then tried 60 ampere Fusetron dual-element fuses. They proved to hold the starting current and to give the needed protection to the motor and generator.

"We are glad we had this experience in our own shop and installed Fusetron fuses before selling the welders. Otherwise, we would have had a flock of costly unnecessary service calls and run the risk of losing customers.

"As it happens, our customers are satisfied with the performance of the welders and we haven't had a service call or complaint about needless fuse blows."

FUSETRON dual-element FUSES do more than eliminate needless blows. They give 10 point protection not available with any other type of protective device.

AND FUSETRON FUSES REMAIN SAFE THRU THE YEARS . . .

. . . without maintenance and recalibration costs.

Once properly installed, Fusetron fuses require no costly inspection time or maintenance necessary on mechanically operated devices.

Dust, fumes, corrosion or age cannot prevent a Fusetron fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuits.

When a Fusetron fuse does open to protect, and after the fault has been corrected—the new Fusetron fuse you install has been calibrated at the factory by engineers—it is a fuse as safe and dependable as the one that blew.

DON'T RISK LOSSES! *One needless shutdown . . . one lost motor . . . one destroyed switch or panel . . . one burned out solenoid . . . may cost you far more than replacing every ordinary fuse with Fusetron dual-element fuses. Write for bulletin FIS.*

For loads above 600 amps.—Use BUSS Hi-Cap Fuses to coordinate your electrical circuits.

On 600 volts or less, BUSS Hi-Cap fuses have an interrupting capacity sufficient to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuits of origin. Write for bulletin HCS.

Bussmann Mfg. Division
McGraw-Edison Co.
University at Jefferson, St. Louis 7, Mo.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Play Safe! Install Fusetron dual-element fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!

957

Doubly-Oriented Magnetic Sheet Will Increase Efficiency of Electrical Equipment

▲ "FOUR-SQUARE" silicon iron, a new kind of sheet material designed to increase the efficiency of transformers, motors and generators, has been developed at the General Electric Research Laboratory. The new doubly-oriented magnetic sheet material, which is easily magnetized in four directions and can be made in a wide range of useful thicknesses, has been produced by theoretical metallurgists working side-by-side with processing experts in the world's most complete metals and ceramics laboratory.

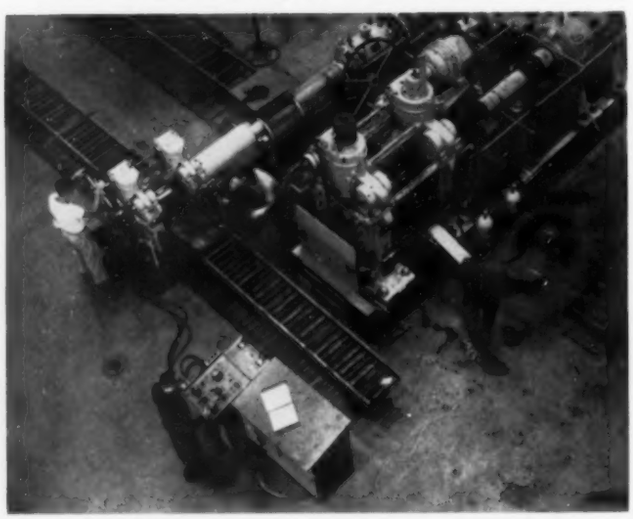
Lower energy losses and reduced noise in many types of electrical equipment can be expected when "four-square" silicon iron gets into actual production.

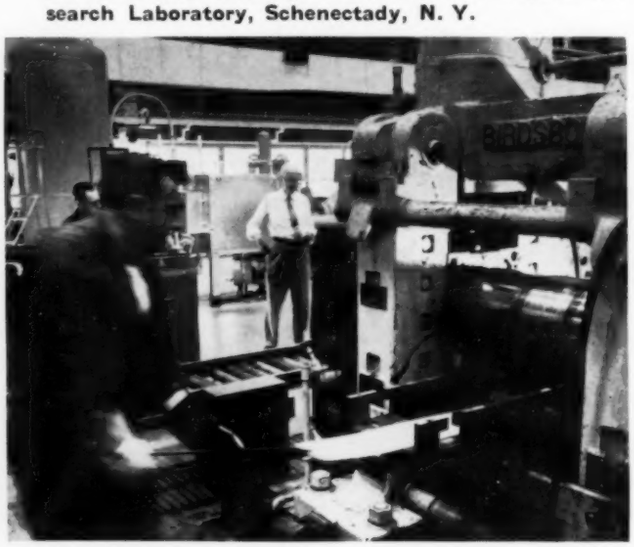
Doubly-oriented magnetic sheet has been a research goal for more than 20 years, ever since metallurgists learned how to make singly-oriented sheet materials that can be easily magnetized in two directions (back and forth lengthwise along the sheet). "Orientation" in silicon iron is achieved by alining the individual crystalline grains in the finished sheet material. The doubly-oriented "four-square" effect is produced by a different kind of alinement (technically referred to as "cube texture") which gives excellent magnetic properties not only back and forth along the sheet but also back and forth across the sheet.

Rigid control of the internal structure of the metal during all steps of processing, from the original casting through successive heat-treating and rolling-mill operations, is the secret of the process. The basic raw material is a form of silicon iron similar in composition—and cost—to the typical kinds of "soft" magnetic sheet used in modern transformers and motors.

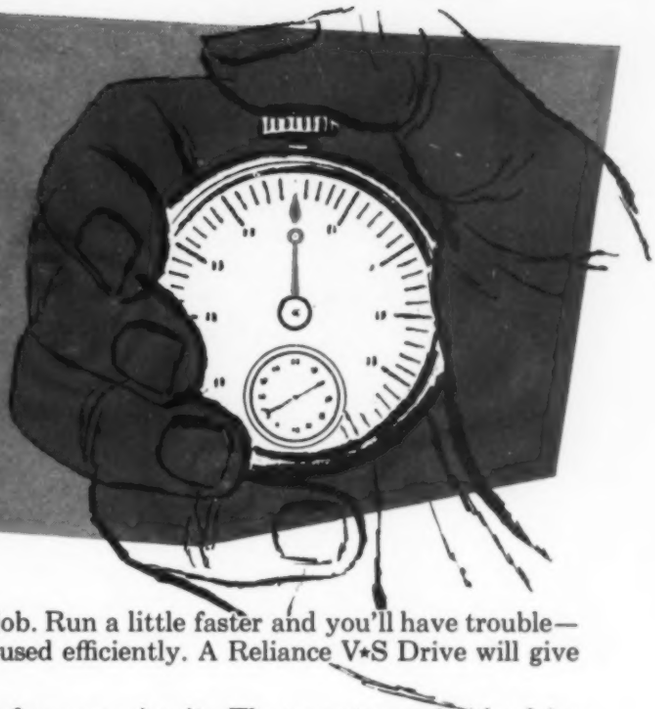
The iron core in a transformer serves as a conductor of magnetic lines of force, guiding them from the primary winding coil to the secondary winding coil. When ordinary 60-cycle alternating current is used, the direction of magnetization changes 120 times every second. The core's resistance to these changes causes a loss of energy—and reduced efficiency through the gen-

Figure 1 (left) — Teamwork is essential in the preparation of "four-square" silicon iron, a new kind of magnetic sheet material designed to increase the efficiency of transformers, motors and generators. The carefully controlled properties of "four-square" iron call for a quick transition from one rolling-mill to another. After a series of rolling operations, both hot and cold, the new material is reduced to the thicknesses required for use in the laminated cores of transformers, motors, and generators. Figure 2 (right) — Proper timing of processing steps is essential in the preparation of "four-square" silicon iron developed in the metals and ceramics building at the General Electric Research Laboratory, Schenectady, N. Y.





how do you measure your production?



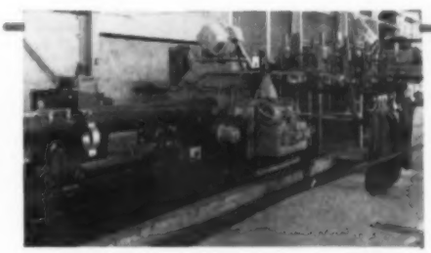
There is a *just-right* production speed for every job. Run a little faster and you'll have trouble—a little slower and your equipment is not being used efficiently. A Reliance V★S Drive will give you the *just-right* speed for each job.

Reliance V★S is an all-electric drive that operates from a-c. circuits. The operator varies the drive motor rpm. to set up the ideal speed for every job. With no rigid set of gear ratios with a limiting number of speeds, he has an infinite selection of rpm.'s from a wide flexible band of operating speeds.

There is a V★S Drive designed for your equipment. Write for Bulletin D-2311.

• TONS PER HOUR

In order to maintain a uniform production rate of 80 tons per hour with varying sizes of pipe, this pipe mill must change its line speed from 30 ft. per minute to 80 ft. per minute to compensate for differing gauges of steel. A 500 hp. multi-motor V★S Drive does the job.



• YARDS PER MINUTE

In order to properly size differing types of cotton cloth, the textile slasher must operate at line speeds varying from 28 yds. per minute to 225 yds. per minute. A 25 hp. V★S Drive does the job.

• REVOLUTIONS PER MINUTE

In order to maintain the correct tension on the metal on this highly accurate rolling mill, the speed of the coil winder must decrease from 900 rpm. to 450 rpm. as the diameter of the roll builds up. A 20 hp. V★S Drive does the job, automatically. D-1563

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 1110A, CLEVELAND 17, OHIO • CANADIAN DIVISION: WELLAND, ONTARIO

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like this ☞

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only one trade-mark
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THERE'S only one Timken and it's a registered trade-mark — stamped on every Timken Company product. It means the name "Timken" is the property of The Timken Roller Bearing Company *alone.*

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That's why it pays to remember that "Timken" is a trade-mark, not just a type of product.

So to be *sure* you get the best, look for the trade-mark "Timken". It's your assurance of quality.

The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TAPERED ROLLER BEARINGS • REMOVABLE ROCK BITS • FINE ALLOY STEEL

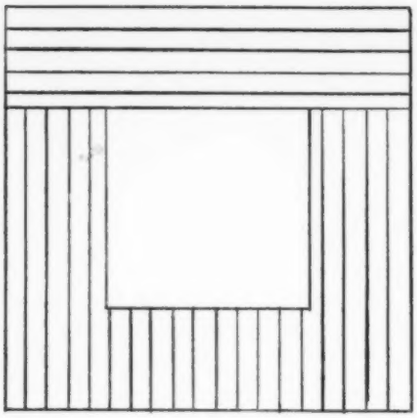


Figure 3 — Advantages of singly-oriented materials can be utilized on three sides of the square.

eration of heat, and also causes actual mechanical vibrations in the core which result in annoying "transformer noise."

Ordinary iron was used in the earliest transformers, and the advantages of increasing efficiency by adding a small percentage of silicon was discovered near the turn of the century. By appropriately lining up the sheet in a transformer, generator or motor, most—but not all—of the magnetic flux could be carried in these "easy" directions. This discovery has had a significant impact on the technology and economics of electrical apparatus. The currently-used product has reduced transformer core losses to a tenth of the original unalloyed iron and a fifth of those of the original silicon-iron alloy. "Four-square" sheet promises even further improvements in efficiency.

In one familiar type of transformer core construction, the advantages of singly-oriented materials can be realized on three sides of the square, although even with this configuration there is still considerable loss at the corners. See Figure 3.

With "four-square" magnetic sheet, a variety of construction arrangements are possible which take advantage of the easy magnetization on all four sides. See Figure 4. The new material also gives a substantial reduction in corner losses.

"Four-square" magnetic sheet is currently in pilot-plant production at the General Electric Research Laboratory. How soon it will be used in transformers and motors depends on "progress in making the new process economic."

It is believed that "four-square" sheet can eventually be produced at approximately the same cost as presently-used materials, but as with all such discoveries there must be a period of advanced development and evaluation before the expected benefits can be incorporated in actual products.

Processing steps for "four-square" iron follow the same general pattern as used in making singly-oriented materials. These steps begin by melting the raw material in a standard furnace. Subsequent rolling and heat-treating of the cast ingots produces long sheets of material approximately 12 in. wide and in any desired thickness for use in the laminated cores of large transformers, motors and generators. For all of these steps, the special equipment of GE's unique metals and ceramics laboratory makes possible carefully-controlled processing on a scale large enough to permit evaluation of the material for large electrical apparatus. This work serves as a "bridge" to multi-ton production in commercial steel mills.

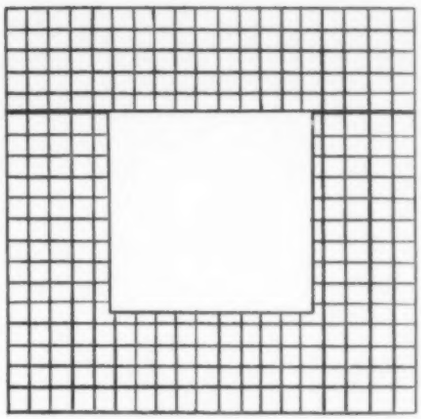


Figure 4 — It is easy to utilize the advantages inherent in "four-square" magnetic sheet.

Specialized Group Maintains Electric Precipitators

PERIODIC SERVICE MAINTENANCE

▲ THE development and expansion of industrial processes during the past fifty years have resulted in gas cleaning equipment becoming an essential part of plant facilities. The technical and economic success of an operation may be dependent upon the selection of the proper gas cleaning apparatus to do the specific job and the proper maintenance to provide the end result for which the unit was originally installed.

Where clean industrial gases are required for special use, the electrostatic precipitator removes waste or harmful materials. With the enormous volumes of gas produced in blast furnace operations, the dust content may run into hundreds of tons of collected dust per week. Much of it is of extremely small size, and the finest particle contains volatile alkalis which cause serious damage to the checkers in the stoves and to the brickwork in soaking pits and open hearth furnaces.

In general, blast furnace gas is cleaned in three stages, any or all of which can be used depending on the degree of gas cleaning required.

1. Preliminary cleaning to remove coarse particles.
2. Primary cleaning after pre-

liminary cleaning to reduce dust content to from 0.5 to 0.1 gr of dust per cu ft of standard gas.

3. Secondary or "fine" cleaning to reduce dust content to 0.02 to 0.005 gr per cu ft of standard gas, depending upon the final utilization of the gas.

The principal application of the electrostatic precipitator to date has been for secondary cleaning the gas following primary scrubbers. The gas so cleaned is delivered free from entrained moisture and dust burden to obtain best results where the gas is used for stoves, soaking pits, open hearth furnaces, boilers, gas engines and underfiring coke ovens.

To achieve the benefit for which the precipitator was installed, the precipitator must be kept in as close to peak performance as possible. This can be done only by periodic inspection, cleaning, and adjustment of the individual components that form a part of the precipitator.

To industry and plants owning and operating electrostatic precipitators, Premsco Inc. offers a service to alleviate the problems that arise from improper and inadequate maintenance.

It has been found through experience, that after the precipitator has been in service for a period of time, the efficiency of the unit decreases. The cause for this drop-off is due, in the vast majority of cases, to improper maintenance, residual buildup in the unit of collected deposits, oxides, laxity on the part of maintenance personnel, and also the unfamiliarity the average plant maintenance worker has of the complex workings of the precipitator. In order that industry may derive the full benefit from the use of a precipitator, a periodic schedule of servicing should be set up which will encompass a thorough cleaning and checking of all the precipitator components.

The ultimate benefit derived in efficiency improvement, decrease in plant maintenance cost and operating assurance will offset many times the nominal charge made for the service.

CHEMICAL CLEANING OF PRECIPITATORS

The electrostatic precipitator constitutes a major and vital component in the present day operation of a progressive steel mill operation. The precipitator performs a very necessary function in reducing production costs and maintaining the allied equipment needed to operate the plant at peak efficiency. As a major component, an investment of thousands of dollars is made in these precipitators, with the objective being to increase production output, decrease operating costs, and provide the best means known of treating blast furnace gases.

Too many plants owning these units, take the precipitator for granted, and figure that once the unit is in operation, no further care is needed to maintain them other than to see that they have a constant water supply and electrical power. Observation has been made of actual operating conditions where precipitators have been in service for 18 to 20 months, with no thought given to maintaining them whatsoever. In these specific cases the precipitators were plugged to the point that the electrical rectifying equipment had been shut off as the unit would not stay on the line owing to the internal buildup. As a result, the components such as boiler house, stoves, etc., were working under dirty conditions and the cost of maintaining these dependent pieces of equipment reached abnormal and unnecessary proportions. Also the word goes around that the precipitators are inefficient, poorly built, etc.

Unfortunately, management had never been informed that maintenance of these units is a must to provide the efficiency that was originally built into these units. Also the cost of properly maintaining these precipitators is far less than what will be expended on repairing the allied components dependent on these precipitators to provide clean gas to them. As an example, the boiler house burners were being cleaned once every shift. Yet when the precipitators were originally installed, and in good operating condition, it was necessary to clean these same burners only once every thirty days. This same frequency of maintenance can be applicable to the other pieces of equipment depending on blast furnace gas for operation.

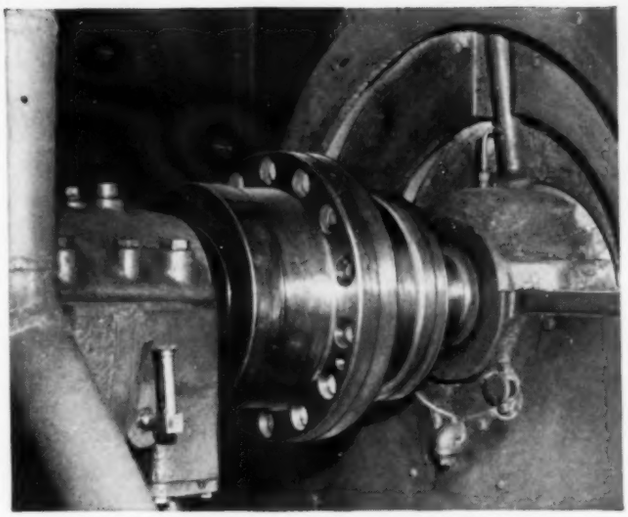
In other cases of maintenance, the trend of servicing these precipitator units has been to the other extreme. Where plant personnel have endeavored to care for the units themselves, they have created damage to the units in not being fully aware of the proper care and attention that these precipitators require. Too many times an untold amount of damage has been done to the interior alignment of the discharge electrodes, weirs, etc., from inexperienced personnel trying to do the job. In a number of cases, a chemical cleaning service has been employed to clean the interior with acid. This method of cleaning is permissible and advisable, but the critical point is to use the proper acid. In acidizing a precipitator, as weak a solution as possible still able to do the work should be used. One improper acid treatment can cause so much immediate deterioration that the collecting electrode alignment bolts which are eaten away will result in loose collecting electrodes, and cause the whole unit to become inoperative from arcing of the discharge electrodes to the tubes. Replacement of the portions of the unit creating the problem can amount to thousands of dollars in material and labor plus the loss of production created by the unit in being out of service.

Premsco Inc. has developed, in conjunction with the largest chemical manufacturer in the country, a special non-corrosive chemical cleaning agent that is not injurious to the many metals that go into the make-up of a precipitator. Only by the proper application of correct cleaning compound to the unit, by technicians trained in the procedure, can industry be assured that they are availing themselves of the best service available to keep these units in the peak of condition for the longest possible life of the unit.

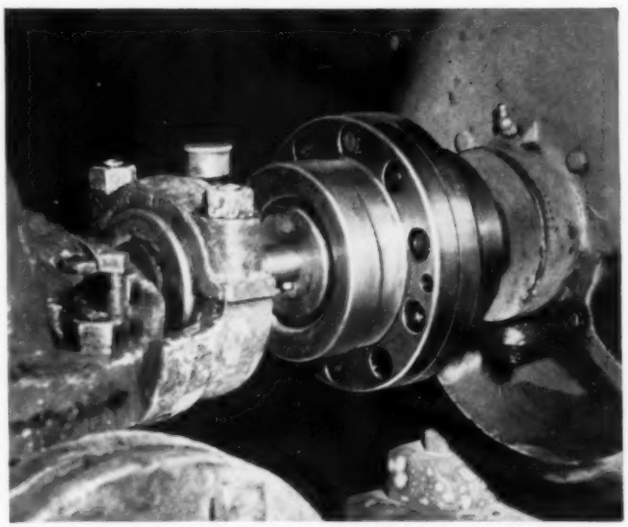
The cheapest way out has proven the most expensive and this is particularly applicable in the care and service of electrostatic precipitation units.

IMPORTANCE OF WEIR MAINTENANCE

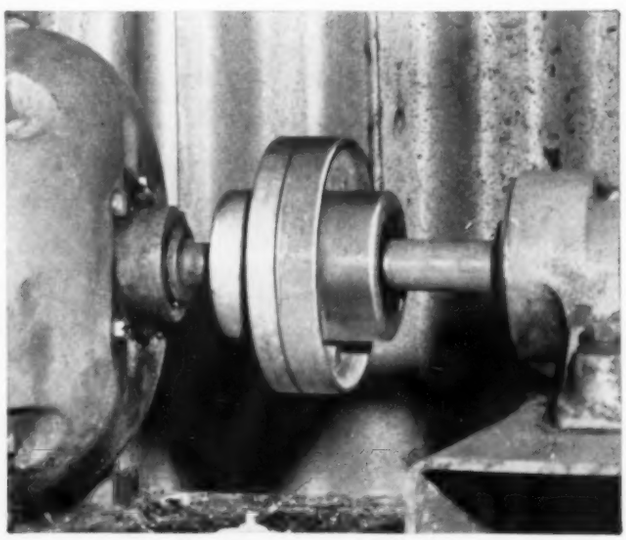
One of the most critical points overlooked in the average plant maintenance schedules, is the improper care and attention given to the water control weirs, which form a very necessary and vital function



Fast's #4½ Coupling on a 1200 GPM Wilson-Snyder descaling pump. A 1500 hp., 1770 rpm motor drives the unit which operates at a head of 1250'.



Fast's #2 Coupling on a Worthington Type 4-L-1 1000 GPM pump operating at a head of 175'. Pump speed is 3570 rpm. Motor is 60 hp.



Fast's #1 Coupling on a 2500 CFM ventilating fan. Fan motor is 1½ hp. Rpm is 1800.

Detroit Steel Keeps 100 Fast's Couplings at Work with Only Minimum Maintenance

Fast's Couplings have reduced costly downtime and maintenance at Detroit Steel Corporation's Portsmouth, Ohio hot strip mill. Over 100 in number, they range in size from #1 to #20. Many of these couplings have operated with practically no maintenance for six years. Detroit Steel chose Fast's Couplings because of their *sound basic design.*

Here's why Fast's design pays off in low-cost maintenance and trouble-free performance: mechanical flexibility compensates for misalignment. Couplings last longer because there's no metal-to-metal wear. Positive lubrication forms a film on load-carrying surfaces. Metal-to-metal seal keeps out dirt, grit and moisture.

For more details, write to KOPPERS COMPANY, INC., Fast's Coupling Dept., 3010, Scott St., Baltimore 3, Md.

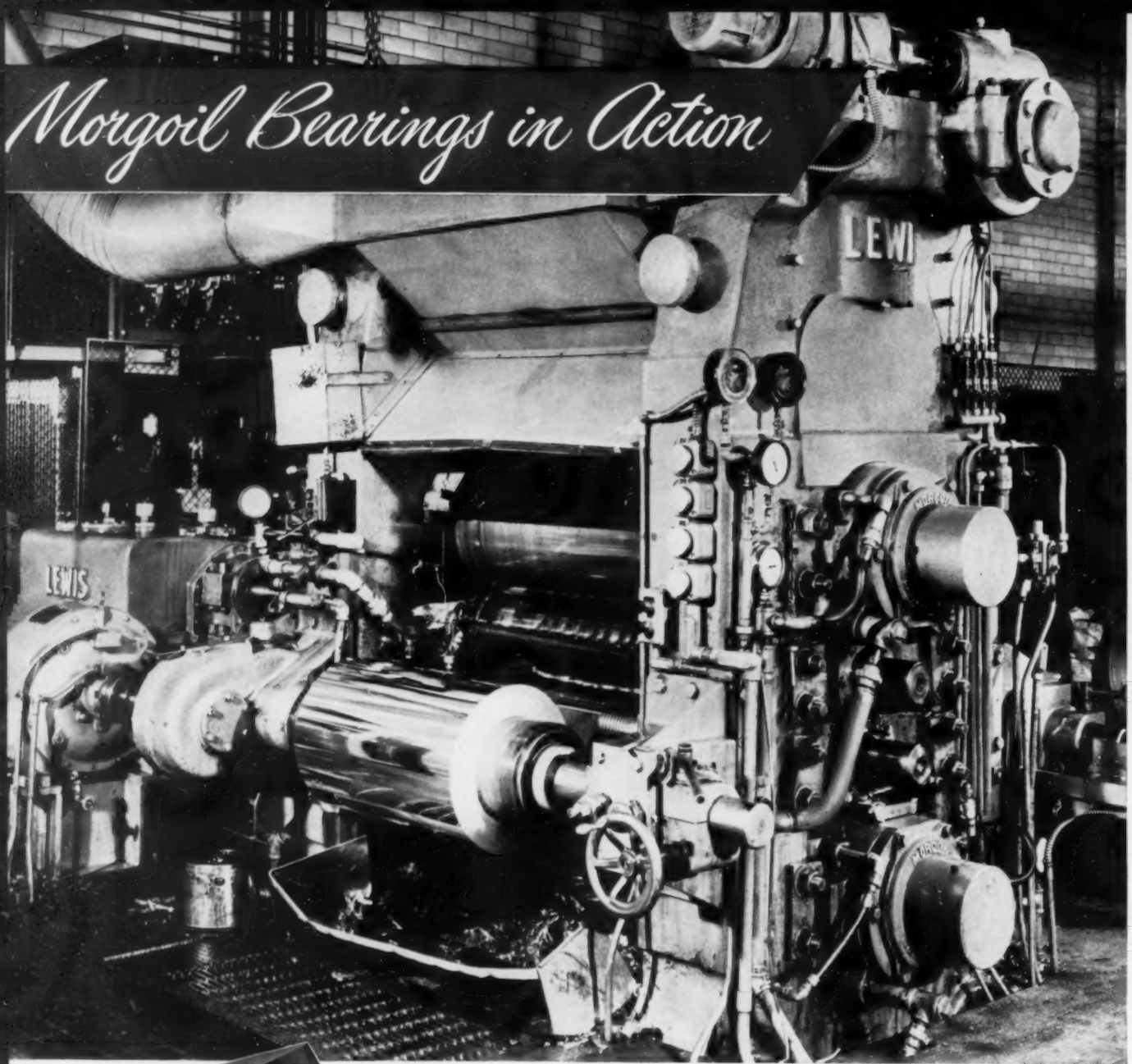
THE ORIGINAL

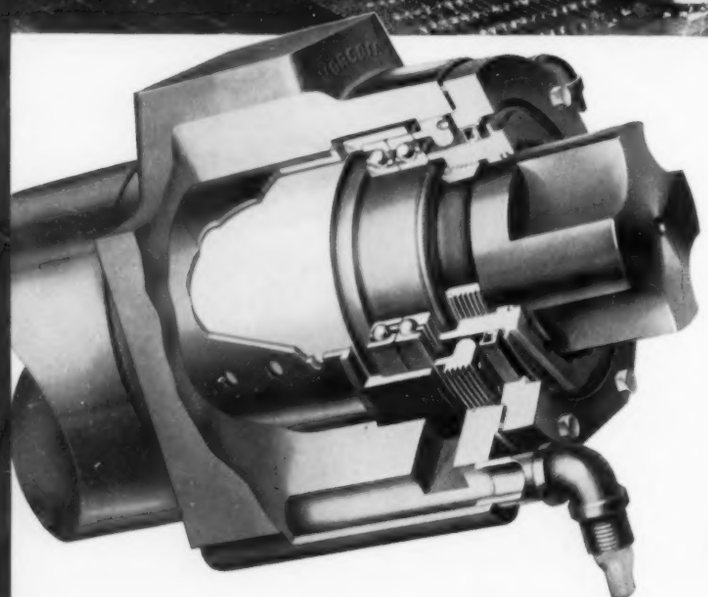
KOPPERS

FAST'S Couplings

Engineered Products Sold with *Service*

Morgoil Bearings in Action





The 18″-72″ MORGOILS on the 9″ and 21″ x 44″ Aluminum Foil Mill at Cochran Foil Co. pictured above make it easier to produce a quality product at high speed. Foil as thin as .00025 of an inch is rolled at speeds approaching 4000 feet per minute on MORGOIL-equipped mills. MORGOIL BEARINGS give you freedom from wear and fatigue and permit operation at high speeds with remarkable long bearing life.

MORGAN CONSTRUCTION CO.

WORCESTER, MASSACHUSETTS

ROLLING MILLS MORGOIL BEARINGS GAS PRODUCERS
WIRE MILLS EJECTORS REGENERATIVE FURNACE CONTROL

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in the proper recovery of entrained dust particles.

These weirs, as originally installed, are calibrated to provide a uniform flow of water down the inside periphery of each and every collecting electrode. In doing this job, the weir must be set precisely, so as to control the flow of water at all times. This flow of water down the collecting electrode, removes the residual deposits, collecting there throughout the normal operation of the unit. Any interruption of this flow of water, by any means, will result in an abnormal buildup in the collecting electrode to such a point that the buildup will cause a shutdown of the whole precipitator, by arcing or electrode burnoff.

Interruption of the flow of water may be caused in many ways. Some of the causes are: residue buildup on the lip of the weir, tipping of the weir in the top of the collecting electrode by careless personnel in servicing the unit, failure of the weir itself through corrosion, or in the majority of cases, the weir may run dry due to water temperature differentials which create expansion and contraction inequalities not uniform to all the weirs in one specific pond area.

To clarify this, engineering data assumes that the weirs will expand equally, one to another, as they are made of the same materials and constructed as near alike as possible. This is not true because of the internal stresses imparted to the metals during their manufacture. No two weirs will react identically to the same water temperature variations. A difference of only a few thousands of an inch in expansion of one weir over another will cause that particular weir to run dry.

The weirs, as originally installed, are all adjusted to a uniform height and flow using water of the same temperature throughout. The water temperature, as the seasons change and operating conditions vary, create a problem in some weirs by increasing in height to such a point that the periphery lip is above the normal water operating level, causing that particular collecting electrode to become dry, while adjacent weirs are actually running at increased capacity to compensate for the dry weirs.

The result of such a condition presents first an abnormal build-up in the collecting electrode since it is not getting water needed for normal service, and secondly the collecting electrode receives an appreciable increase of water and may possibly have a tendency to arc over to the high tension frame. This results in poor and spasmodic operation plus possible shutting down the electrical rectifying equipment.

From these observations, and from actual case histories, too much stress cannot be made as to the necessity of periodic examination of weir conditions and water flow over these weirs. In many cases, where the variations are from one extreme to another in water temperatures, the weirs must be inspected and adjusted on three to four month intervals.

Operating efficiencies are directly affected by the provision of a continuous flow of water over each and every collecting electrode within the precipitator.

MAINTENANCE SERVICE COST COMPARISON

The following are two specific case histories of steel mill operations that reflect the economic savings realized in the use of specialized service on maintaining electrostatic precipitators.

Company A.—Precipitator was serviced approximately every four months by plant personnel plus the services of an industrial cleaning organization that provided only acid pumping facilities. The cost of this plant operation was as follows:

Industrial cleaning service charge	$1667.00
Plant labor—8 men @ 8 hr per day, 7 days @ $2.00 per hr	1016.00
Plant labor—2 men @ 8 hr per day, 2 days @ $2.75 per hr	87.00
Plant labor—Supervision—56 hr @ $3.00	168.00
	$2938.00

To this was added the extra time delay involved in lost time due to the unfamiliarity of the workers to the work involved. When the job was completed, there was still much to be desired to class the finished service as complete and thorough. There were a number of critical operating points overlooked due to the inexperience of the personnel that worked on the unit.

Company B.—Precipitator was serviced approximately every three months by plant personnel plus the services of an industrial cleaning service, in much the same manner or pattern of service as Company A. The periodic cleaning by this company usually took two weeks to accomplish the service of the unit with an end result that the unit was put back on the line in little better condition than when it was taken off. The cost of service to this company, using their own personnel and the chemical service as mentioned, is as follows:

Industrial cleaning service charge	$1850.00
Plant labor—6 men @ 8 hr per day, 14 days @ $2.00 per hr	1344.00
Plant labor—2 men @ 8 hr per day, 3 days @ $2.75 per hr	132.00
Plant labor—Supervision—112 hr @ $3.00	336.00
	$3662.00

Premsco Inc. was delegated the work of servicing these same precipitators on an annual basis, with the following results.

Company A was provided a net decrease in cost of servicing the unit amounting to 33 per cent over the previous costs, plus the fact that the unit operating efficiency was improved over and above the efficiency that was originally attained at the time the unit was first put into service. The company also realized a definite increase in heat attainment of the stoves utilizing the gases cleaned by these precipitators. The increase of heat amounted to approximately 25 per cent above the previously attained heat range.

Company B was provided a net decrease in cost of servicing the unit amounting to 29 per cent over previous costs. The same end result in improved efficiency was obtained by this company as was the previously mentioned company.

Both companies realized a definite saving in outage time, as these units were returned to service in half the time that had formerly been taken to service the precipitators.

Figure 1 — It takes a lot of grease to keep a blast furnace going. Plant use averages about 650 lb per month.

Lithium-Based Grease Reduces Blast Furnace Lubrication Costs

▲ IN a steel mill nothing is as critical as the blast furnace. It produces the pig iron needed to keep every subsequent operation going and the expense of shutting it down for any reason cannot be tolerated.

One of the factors contributing to the smooth, uninterrupted flow of raw metal from the furnace is proper lubrication. At the Detroit Steel Co., Portsmouth, Ohio, every effort was made to maintain a lubrication system as simple and fool-proof as possible. With the advent of lithium-base multi-purpose greases, many of the problems encountered heretofore were eliminated. Failures and overall lubrication costs have been markedly reduced.

Pumpability vital—Pumpablity of a grease is vital, and this pumpability must be retained regardless of temperature.

Consider, for example, what happens to a skip hoist tub in the winter. It may be loaded in the open at temperatures as low as −10 F. Once loaded, it races to the top of the furnace where the temperature is usually well above 110 F. Despite these sudden and oft-repeated temperature fluctuations, the grease in bearings must continue to function without channeling, separating or hardening. Experience has shown that lithium-based grease meets these severe demands.

Cold weather is not the only fly in the lubrication engineer's ointment. Too much heat can also cause trouble. Some types of greases begin to carbonize upon exposure to heat, clogging lines and impairing furnace operations. Others, upon repeated heating and cooling, break down and lose their effectiveness. Lithium-based grease stands up well at temperatures up to 300 F.

Simplified training—Conditions in a steel plant are constantly changing and usually a lubrication foreman does not have the same crew man working with him for too long a period. Men advance to higher positions as soon as their experience warrants it. Oilers are also shifted to other jobs just as they learn the routine. Whatever the reason, the foreman finds that he is almost constantly training new men; he welcomes anything which will make it easier for him and the oiler to turn in a competent job.

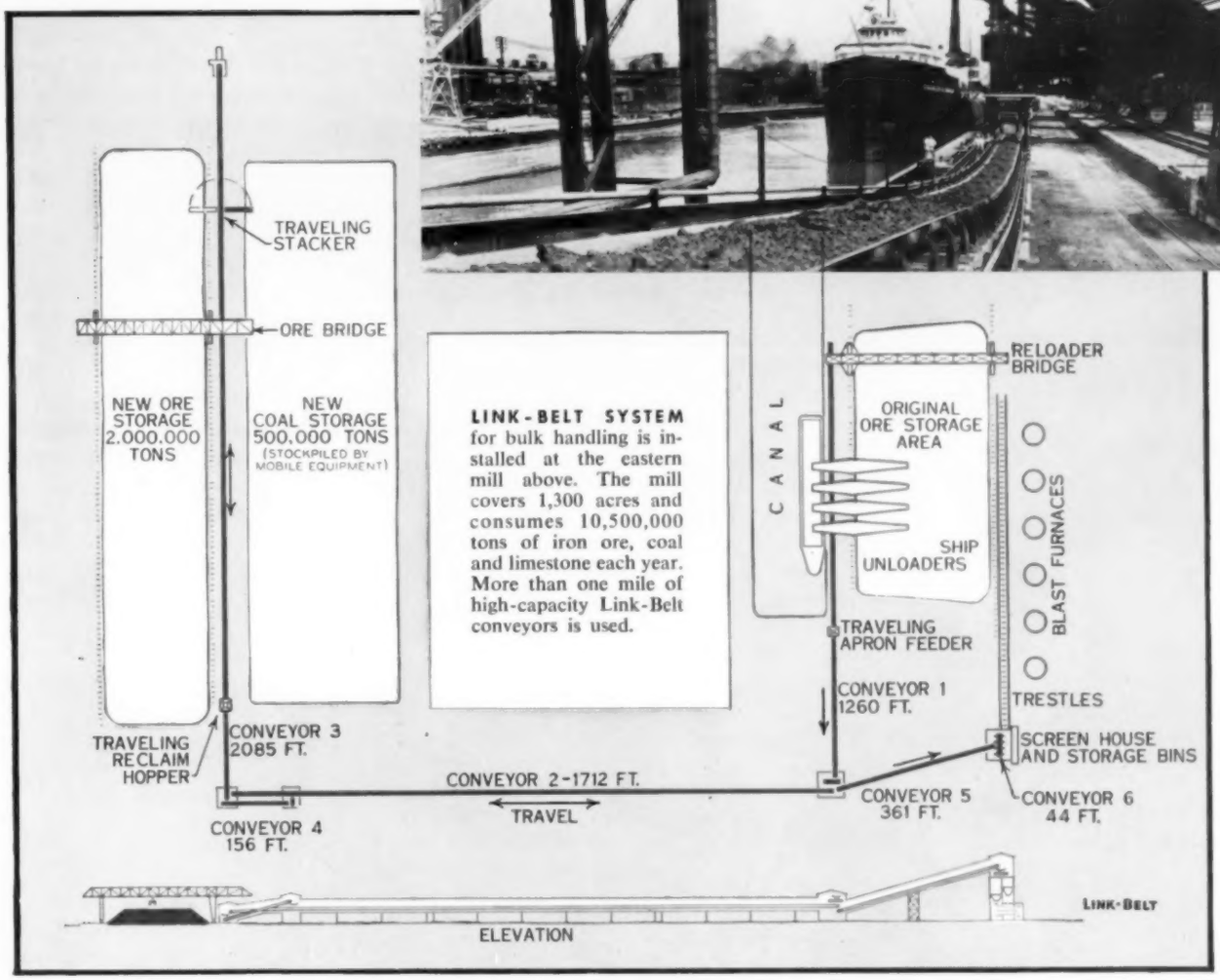
In this case lithium-based grease is a real boon because it can be applied wherever there is a grease fitting. Oilers will not make the mistake of applying a sodium-based grease (high-temperature resistant) when actually a calcium-based product (water resistant) was needed or vice versa. Alvania grease, a product

TABLE I
Typical Lithium Grease Properties (Alvania EP Grease 2)

Color	Dark amber
Texture	Smooth
Soap (kind)	Lithium
Soap (percentage)	7–9
Dropping point ASTM (F)	360 minimum
Mineral oil (SUS at 210 F)	75 minimum
Consistency ASTM	
Unworked	290
Worked 60 strokes	280
Worked 180 strokes	280
Worked 300 strokes	282
Worked 10,000 strokes	295
Worked 100,000 strokes	305
Timken OK test	43 lb minimum

How LINK-BELT raw materials handling systems

keep pace with today's burdening techniques


TRAVELING STACKER
ORE BRIDGE
NEW ORE STORAGE 2,000,000 TONS
NEW COAL STORAGE 500,000 TONS (STOCKPILED BY MOBILE EQUIPMENT)
LINK-BELT SYSTEM for bulk handling is installed at the eastern mill above. The mill covers 1,300 acres and consumes 10,500,000 tons of iron ore, coal and limestone each year. More than one mile of high-capacity Link-Belt conveyors is used.
CANAL
RELOADER BRIDGE
ORIGINAL ORE STORAGE AREA
SHIP UNLOADERS
BLAST FURNACES
TRAVELING APRON FEEDER
CONVEYOR 1 1260 FT.
TRESTLES
TRAVELING RECLAIM HOPPER
CONVEYOR 3 2085 FT.
SCREEN HOUSE AND STORAGE BINS
CONVEYOR 2-1712 FT.
TRAVEL
CONVEYOR 5 361 FT.
CONVEYOR 6 44 FT.
CONVEYOR 4 156 FT.
ELEVATION
LINK-BELT

Meet the demands of greater blast furnace output with improved conveying efficiency

MODERN, more productive blast furnace burdening techniques—developed in answer to growing steel demand—have multiplied problems of storing and reclaiming bulk materials. Higher tonnages, more extensive storage areas, separate stockpiles for a greater number of individual ores—all increase the importance of integrated, high-capacity materials handling.

As one of industry's largest, most experienced conveying specialists, Link-Belt offers one source for engineering and equipping such systems for both new and expanding mills. Systems designed to make the most of existing space . . . handle increased capacities.

Our engineers are available to work with your own staff and consultants in mechanizing raw materials flow at your mill. Your nearest Link-Belt office will be glad to arrange a consultation at your convenience. 14,553

LINK-BELT

MATERIALS HANDLING, PROCESSING AND POWER TRANSMISSION MACHINERY

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World.

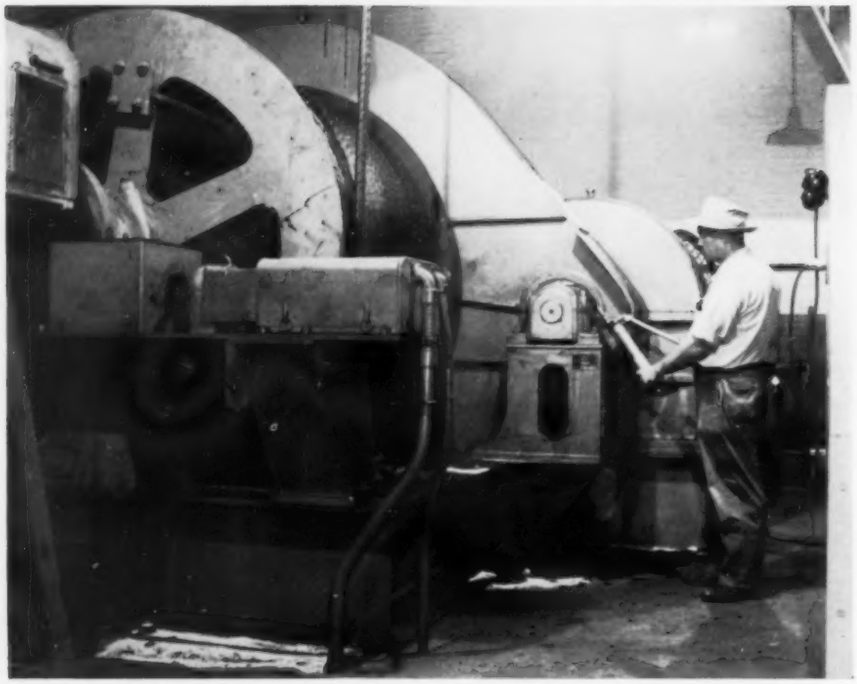


Figure 2 — High pressures prevail in main bearings of skip hoist drive. Periodic lubrication helps avoid shutdowns.

of Shell Oil Co., can be used, since it has both water and high-temperature resistance. Mistakes are avoided and an excess of grease drums and dispensing equipment plus added inventory are eliminated.

Using Alvania extreme pressure grease to lubricate the furnace and its accessory equipment, fans, blowers and ore bridge motors are hand-greased once a month. Skip hoist car wheel bearings, transfer cars, crane and ore bridge bearings are checked during every eight-hour shift and grease added if necessary.

Coke breeze conveyor, furnace sheaves, and distributor are automatically lubricated. Every 12 hours, from 0.007 to 0.04 oz of multi-purpose grease ore injected into conveyor bearings. Other doses are: 0.04 oz every three hours for the sheaves; from 0.02 to 0.04 oz every two hours for each lubrication point on the distributor.

With other greases, the grease pump must be set to generate a system pressure as high as 800 psi to make sure grease is forced through the fairly long lines. However, because of the good pumpability of the lithium-based grease, it is unnecessary to build up such pressures.

When replacing several different lime, calcium or sodium-based greases, as well as some special high-temperature lubricants with Alvania multi-purpose grease, it is only necessary to begin pumping the new grease, using it to purge the old grease out of the bearings—no signs of incompatibility are experienced.

Significant savings—At the Detroit Steel Co., detailed operating records kept on both a new furnace utilizing lithium-based grease in a fully automatic lubricating system, and on an old furnace using a number of other greases, showed that the lubricating costs per ton were twenty per cent less on the new furnace. This, despite the fact that the new furnace had twice the capacity of the old one, many more lubrication points, and was using a more costly grease.

Considering that this furnace consumed 650 lb of grease per month, this saving assumes added significance.

Pittsburgh Makes Noteworthy Progress*

by MAX D. HOWELL

Executive Vice President, American Iron and Steel Institute, New York, N. Y.

▲ PITTSBURGH's world famous iron and steel industry has been making noteworthy progress recently. Every hour this year, from January to September, an average of over 4,400 tons of raw steel has been made in the Pittsburgh-Youngstown district. The average was about 3,900 tons per hour a decade earlier.

Because production is our business, we are naturally impressed by the great amount of industrial activity and expansion. The greatest steelmaking district in the United States, the Pittsburgh-Youngstown district has produced a record amount of steel, totaling some 425,000,000 tons, since the end of World War II. That is equal to about 35 per cent of all the postwar steel made in this country. Meanwhile, the greatest output in any other district is below that figure by about 175,000,000 tons.

The district has expanded remarkably and will continue to grow. Between 1946 and 1956, the annual steel output of the Pittsburgh-Youngstown area increased more than 14,000,000 tons, or more than 50 percent.

In achieving modernization, Pittsburgh faced a task more difficult than any other city because of the natural obstacles there. Extraordinary engineering projects have been required. In constructing its new buildings, bridges, throughways and tunnels—Pittsburgh has been one of its own best steel customers.

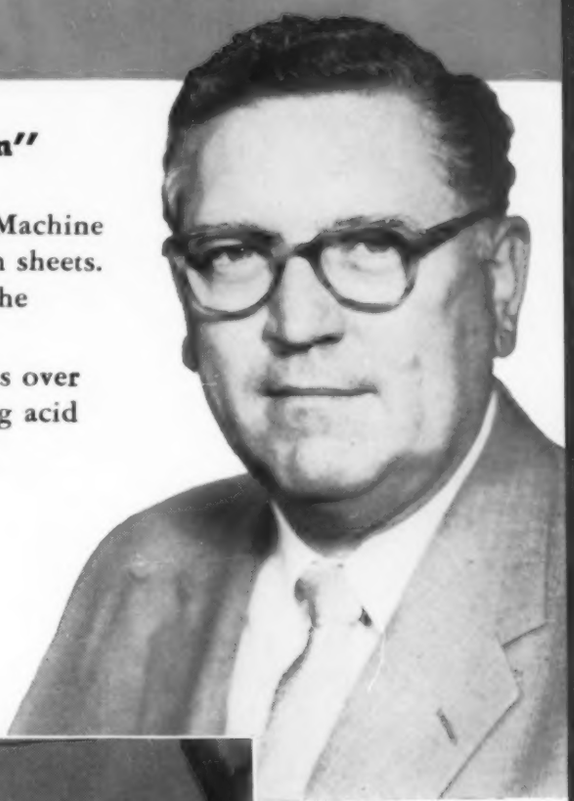
With all the new features—which give this city a remarkably bright, new appearance—Pittsburgh will have a great story to tell the rest of the world in connection with the Pittsburgh bicentennial program next year.

Here, as elsewhere, America is going forward and all of us in the iron and steel industry are proud to have a part in its progress.

* Abstracted from talk given at AISI Pittsburgh Regional Meeting, Oct 2, 1957.

"...an all-round solution to the problem of removing scale from sheets"

says T. A. SULLIVAN, Plant Manager,
Granite City, Ill. Works, A. O. Smith Corporation



"Extremely pleased with high volume of production" of PANGBORN DESCALING MACHINE

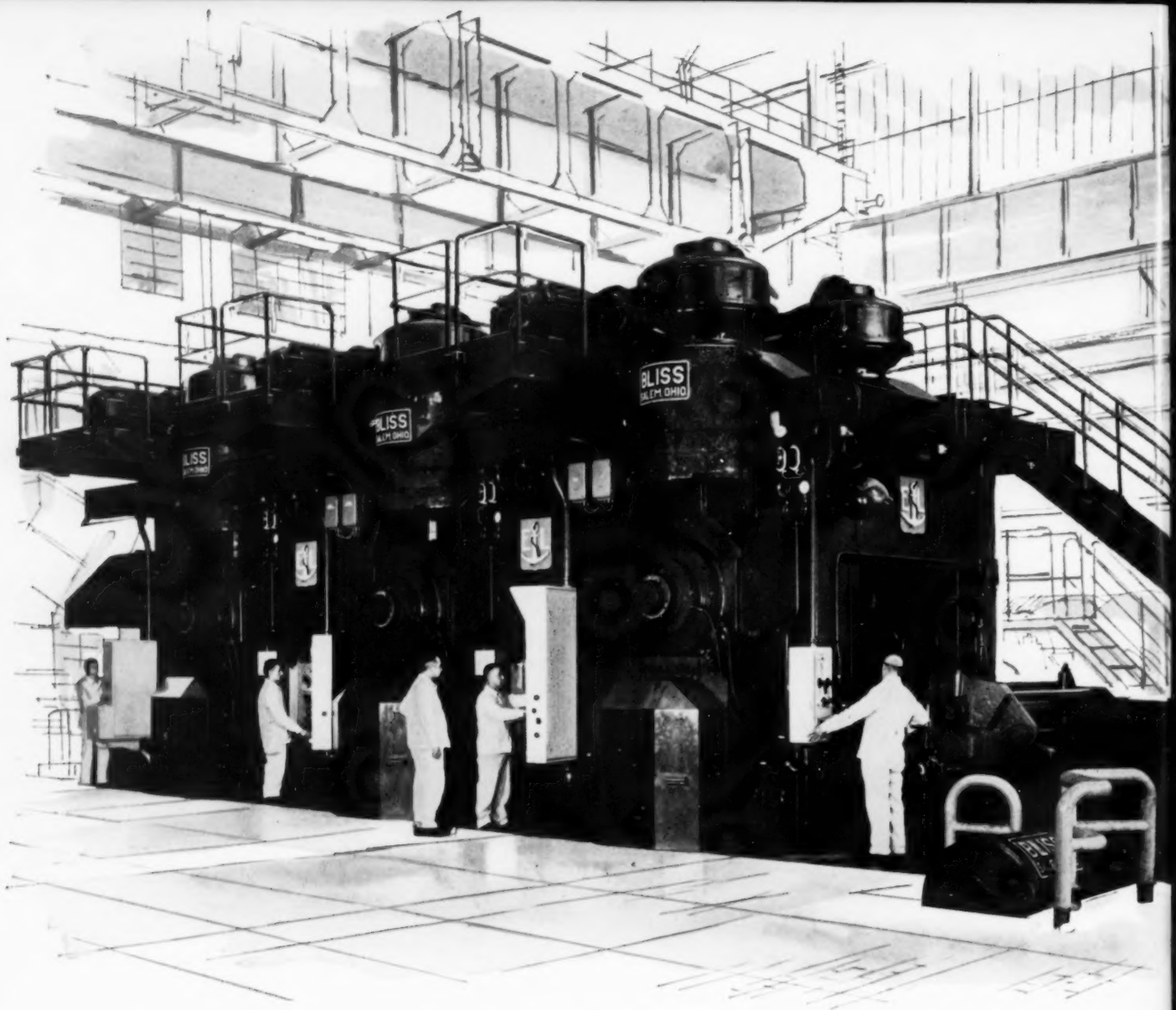
"In many ways," says Mr. Sullivan, "the Pangborn Descaling Machine is an all-round solution to the problem of removing scale from sheets. We're extremely pleased with the high volume of production the machine is handling . . . it's fast and thorough."

And A. O. Smith management rates the following advantages over pickling equally important: conserving floor space—eliminating acid disposal problems and hazards to employees—better working conditions and plant housekeeping—more fully automated plant that saves time and labor.

If you're descaling sheets, plates, coils and rods, write today for Bulletin 608, PANGBORN CORP., 4400 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Blast Cleaning & Dust Control Equipment.*

At A. O. Smith, sheets descaled on this Pangborn Descaling Machine draw easily, weld readily . . . and the fine matte surface takes a permanent bond.

Pangborn ROTOBLAST® cleans cheaper



Espérance-Longdoz increases cold-rolling capacity with new Bliss mill

This 3-stand 4-high tandem mill at Ste. Ame. d'Espérance-Longdoz in Liège, Belgium is the first large multiple stand rolling mill in the Benelux countries. Built by Bliss' Rolling Mill Division, it rolls steel strip up to 52" wide from hot-rolled band down to thin cold-rolled strip. Mechanized entry and delivery equipment almost eliminate manual coil handling.

This modern cold reduction tandem mill is much more than ample for Espérance-Longdoz to convert its present 600,000-ton hot-rolled production. What's more, the mill is designed to allow later addition of a fourth stand.

This installation is a typical example of how Bliss engineers design a mill to meet a customer's particular rolling problem. For other examples, write for our 60-page Rolling Mill Brochure, Bulletin 40-A.

BLISS
SINCE 1857

100 years of making metal work for mankind

E. W. BLISS COMPANY, Rolling Mill Division, Salem, Ohio

Subsidiary: The Matteson Equipment Company, Inc., Poland, Ohio

GENERAL ELECTRIC ANNOUNCES . . .

NEW surface-mounted • desk-mounted mill-duty master switches

NEW SMALL SIZE

Both General Electric master switches feature new small size. The surface-mounted switch is 25 percent smaller than previous models, and the desk-mounted switch is the smallest switch of its type on the market today!

NEW PHENOLIC CAMS

Rugged phenolic cams are impregnated with graphite to increase their service life. These U-shaped cams are easily interchanged to alter the contact sequence. This is done without complete disassembly of the switch.

NEW STEEL CAM FOLLOWERS

Steel cam followers actuate the contacts with a positive action. These cam followers swing clear to allow access to internal switch components. G-E cam followers are designed for millions of operations with minimum maintenance.

NEW CONTACT BLOCKS

Unit-type contact blocks are interchangeable between both types of General Electric master switches, thus reducing the number of spare parts required. Silver-tipped contacts give long service life with little or no maintenance.

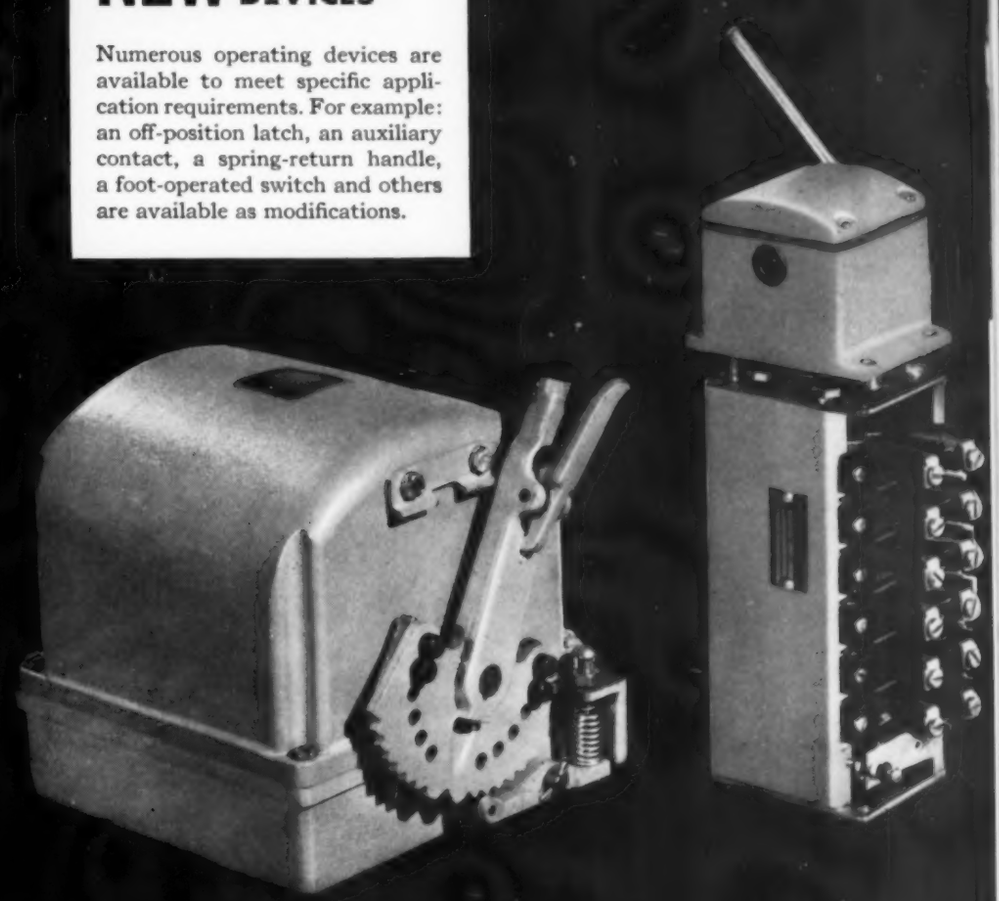
NEW OPERATING DEVICES

Numerous operating devices are available to meet specific application requirements. For example: an off-position latch, an auxiliary contact, a spring-return handle, a foot-operated switch and others are available as modifications.

NEW BULLETIN AVAILABLE

Like to know more? For complete information on General Electric's new mill-duty master switches, contact your General Electric Apparatus Sales Office. And write today for the new descriptive bulletin, GEA-6706, to Section 784-9, General Electric Company, Schenectady, N. Y.

Industry Control Dept., Roanoke, Virginia.

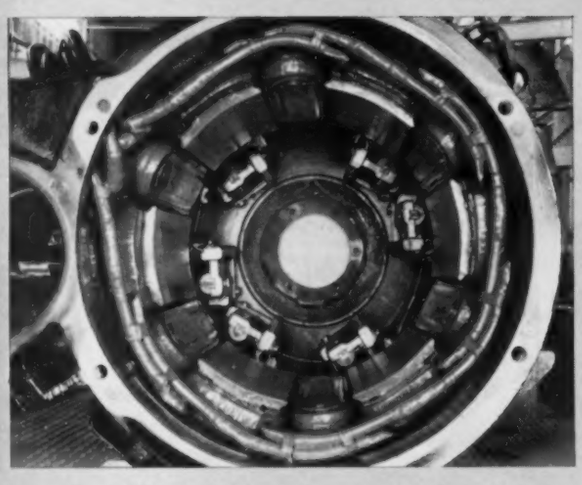


Progress Is Our Most Important Product

GENERAL ELECTRIC

Here's why NATIONAL Plastic Molded COPPER-CLAD Field Coils

Insure Longer Service Life



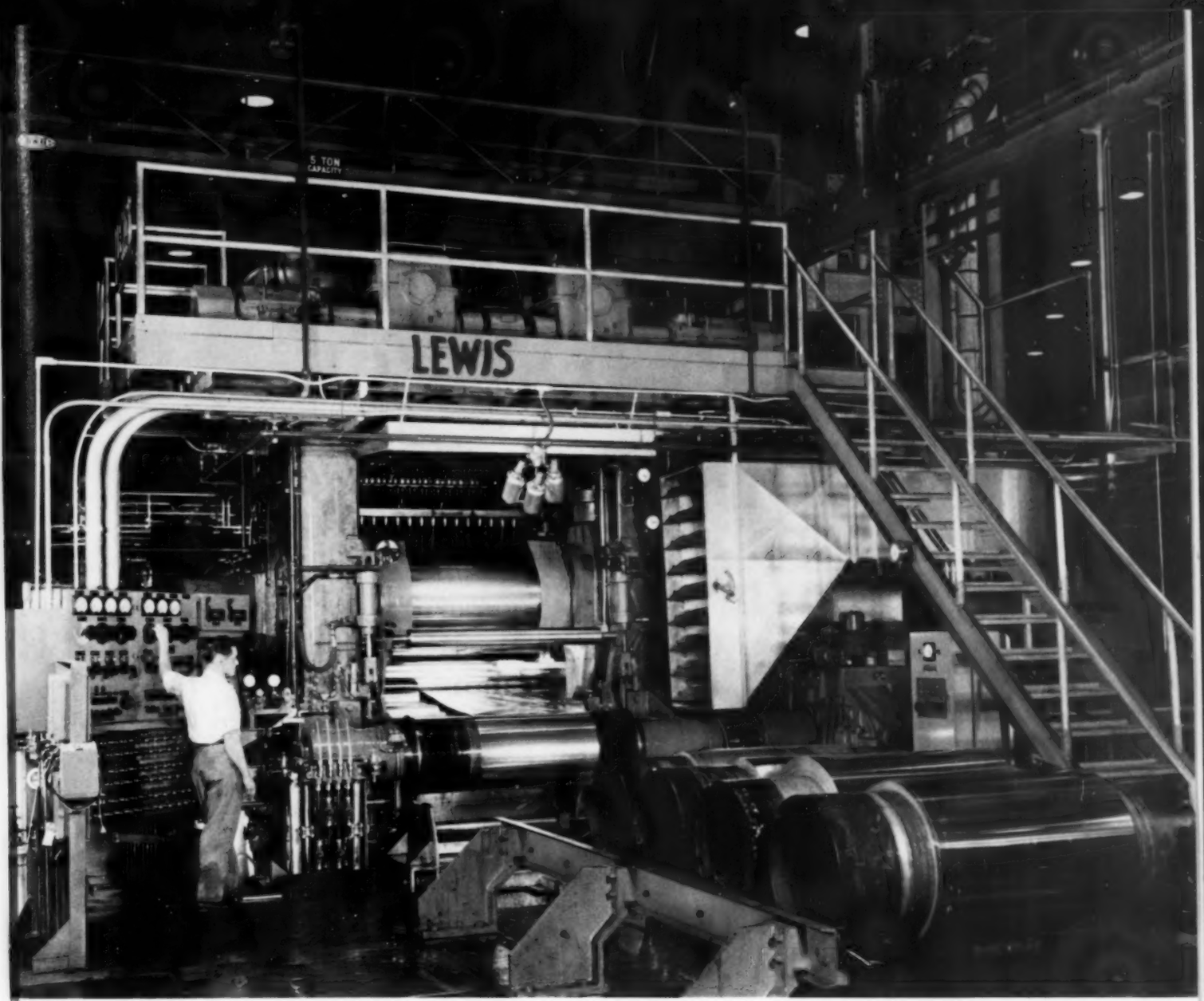
The main illustration shows a plastic molded, copper-clad interpole field coil for a railway traction motor. The small photo shows a set of such coils assembled with main field coils of the same construction in a traction motor frame. For details on how National plastic molded, copper-clad field coils can help reduce your motor maintenance problems, just drop us a line or call your nearby National field engineer.

1. Snug fit on pole piece eliminates coil movement and provides maximum heat transfer to the frame.
2. Monolithic construction resists damage from mechanical stresses and insures maximum heat dissipation.
3. Void-free insulation prevents penetration of oil, moisture and other deteriorating agents.
4. Proven heat-resistant impregnant imparts high temperature endurance.

NATIONAL ELECTRIC COIL COMPANY

COLUMBUS 16, OHIO, U. S. A.

ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION—
REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES



9½ and 34-inch by 60-inch Foil Mill at Kaiser Aluminum and Chemical Corporation, Ravenswood, W.Va.

BLAW-KNOX
ALUMINUM FOIL MILLS

Blaw-Knox designs and builds a full range of Aluminum foil mills complete with auxiliary equipment to meet individual requirements. Other Blaw-Knox equipment for metals industry includes complete rolling mill installations including all auxiliary equipment for ferrous and non-ferrous metals, iron, alloy iron and steel rolls, Medart cold finishing equipment, carbon and alloy steel castings, fabricated steel plate or cast-weld design weldments, steel plant equipment, and heat and corrosion resisting alloy castings.

BLAW-KNOX

BLAW-KNOX COMPANY

Foundry and Mill Machinery Division
Blaw-Knox Building • 300 Sixth Avenue
Pittsburgh 22, Pennsylvania

BLAW-KNOX-Medart

provides high speed, precision finishing at American Steel and Wire Cold Drawing Plant

Two Blaw-Knox–Medart high speed, precision straighteners are handling the output of the new drawing line at the Cleveland Plant of the American Steel and Wire Division of U. S. Steel. The line operates at straightening speeds of up to 450 feet per minute on bars ranging in diameter from 1-inch to 4½ inches. The line is completely automated to the extent that bars are fed automatically from the shear to the stocking tables, into the feed troughs for the straighteners, through the straighteners and into the discharge storage cradles.

Either of these 2 and 2 Medart straighteners is capable of handling the entire output of one of the high speed draw benches. High throughput is achieved by means of a completely enclosed V-belt drive to each roll. Roll speeds are synchronized by means of electrical interlocks between the motors.

The Blaw-Knox–Medart Straighteners are standard equipment for straightening and polishing in a direct production line with a draw bench. They are available in sizes to handle bars and tubes in diameters of ⅛-inch to 10 inches. Contact your Blaw-Knox representative for information, assistance or service.

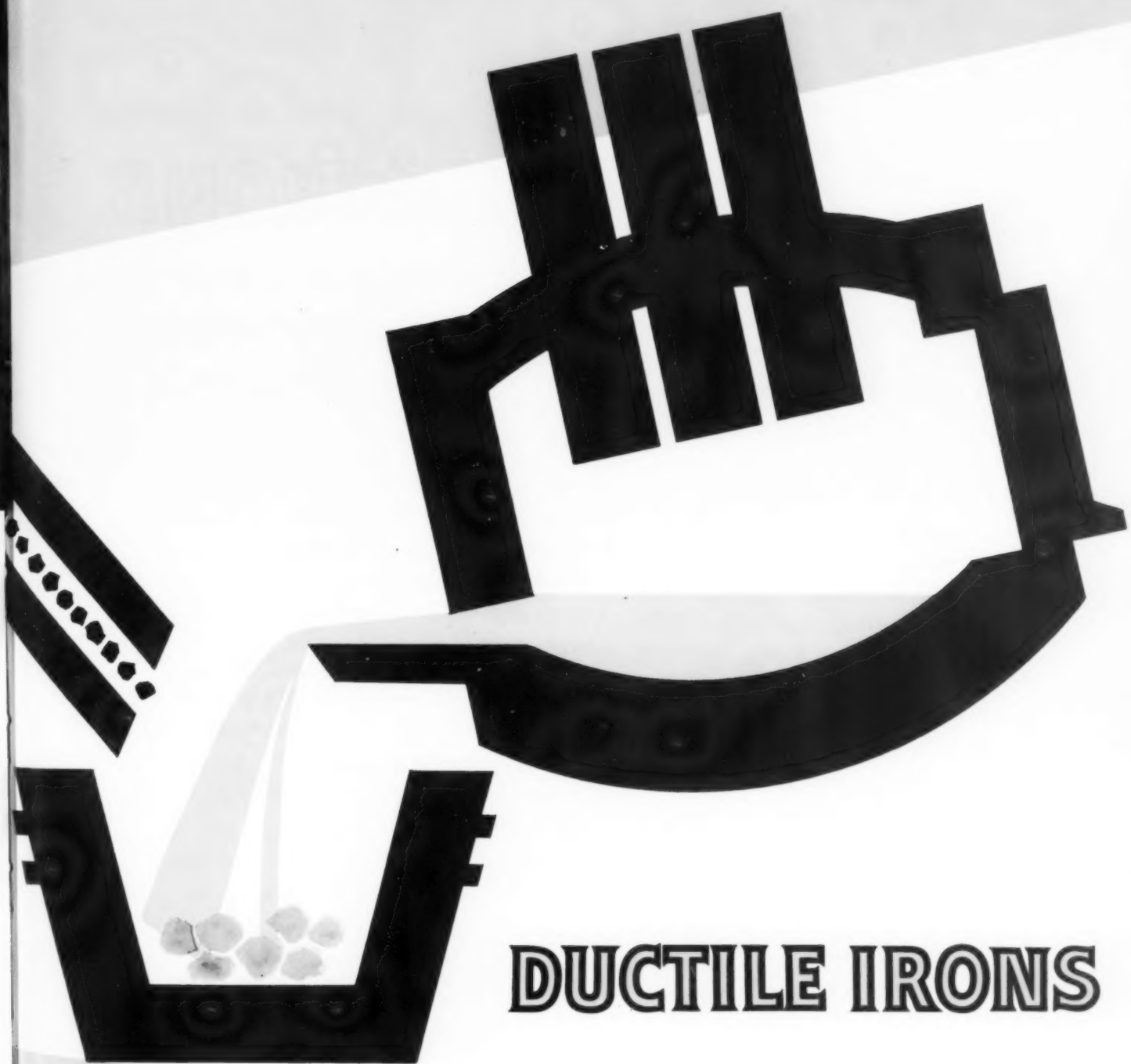
BLAW-KNOX

BLAW-KNOX COMPANY

Foundry and Mill Machinery Division
Blaw-Knox Building · 300 Sixth Avenue
Pittsburgh 22, Pennsylvania

NATIONAL CARBON COMPANY'S

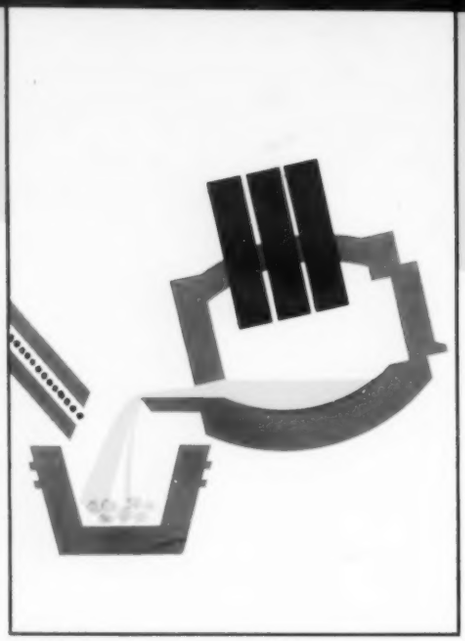
CARBON AND GRAPHITE NEWS



DUCTILE IRONS

a new family of metals for industry

Copyright 1957, Union Carbide Corporation



ANOTHER ELECTRI

Today, many foundries ar
close metallurgical contr

DUCTILE IRONS

This relatively new family of cast metals has proved the most outstanding foundry development since malleable iron.

Today, industry has available to it a relatively new material known as ductile irons. Unlike ordinary cast iron, ductile irons can be bent, twisted, drawn or otherwise deformed without fracturing. These ductile irons, to a large degree, bridge the gap which long existed between cast iron and steel.

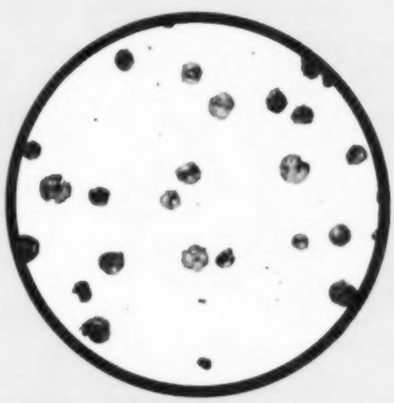
Ductile irons have the processing advantages of cast iron — good fluidity and castability, ready machinability and low melting point — combined with many of the engineering advantages of steel — good strength, toughness, heat resistance and substantial ductility. Ductile iron has several times the strength of ordinary gray iron, exceptional resistance to impact shock and excellent resistance to oxidation and growth at elevated temperatures.

I URNACE PRODUCT...

ar ing the electric arc furnace to achieve the
tr nd critical analyses needed for ductile iron.

UNIQUE GRAPHITIC STRUCTURE

Gray iron — random graphite flakes, unetched, magnification 100 X.



Ductile iron — random graphite spheroids, unetched, magnification 100 X.

Ductile iron is cast iron in which graphite is present as spheres or spheroids of characteristic structure, in contrast to the flake graphite in gray iron or compacted aggregates which distinguish malleable iron. Ductile iron is also known as nodular iron, nodular graphite iron, spherulitic iron, spheroidal graphite iron and SG iron.

The total carbon content of ductile iron is the same as that of gray iron. Spherulitic graphite particles are formed during solidification by the addition of a very small percentage of magnesium in the molten metal prior to casting. The startling change in the microstructure achieved by causing the graphite to take a spheroidal shape removes the former weakening and embrittling effects. The graphite now is in a shape which presents the minimum number of surface discontinuities in the surrounding metal, and a far stronger, tougher and ductile material is attained.

DUCTILE IRON SPECIFICATIONS

There are four specifications covering grades of ductile irons as set up by the ASTM. They are designated as 60-45-10, 80-60-03, 100-70-03 and 120-90-02. The numbers refer, respectively, to minimum tensile strength in 1,000 psi, minimum yield strength in 1,000 psi, and minimum elongation on percent. These specifications are summarized in Table 1.

Type	Typical Range of Mechanical Properties					Specifications
	Tensile Strength psi	Yield Strength psi	Elongation %	Hardness Brinell	Charpy Impact Unnotched (Ft.-Lbs.)	
60-45-10	60/80,000	45/60,000	10/25	140/200	60/115	ASTM A339-55 MIL-I-11466 (ORD.) MIL-I-17166 (SHIPS) (1) AMS #5315 (2) ASTM A395-55T (3)
	(1) Requires 40,000 psi yield and 15% elongation, also specific chemical composition and metallurgical structure. (2) Requires 15% min. elongation. (3) Requires 15% min. elongation, also specific chemical composition and other casting specifications.					
80-60-03	80/100,000	60/75,000	3/10	200/270	15/65	ASTM A339-55 MIL-I-11466 (ORD.) AMS #5316
100-70-03	100/120,000	70/90,000	3/10	240/300	35/50	MIL-I-11466 (ORD.) (4) ASTM A-396-55T
	(4) Requires 75,000 psi yield and 4% elongation.					
120-90-02	120/150,000	90/125,000	2/7	270/350	25/40	MIL-I-11466 (ORD.) ASTM A-396-55T
Heat Resistant (5)	60/100,000	45/75,000	0/20	140/300	5/115	
	(5) Typical composition range: T.C. 2.8/3.8%, Si 2.5/6.0%, Mn .20/.60%, P .10% max., Ni 0/1.5%. Although resistance to oxidation increases with silicon content and is excellent at 6% Si, most castings are purchased at 3.0/4.5% Si which provides the best compromise between mechanical properties and oxidation resistance. This grade is not recommended for applications involving severe thermal shock.					
High Alloy	54/74,000	32/38,000	4/40	140/200	*Vee Notched* 10 to 28	MIL-I-18397 (SHIPS) AMS #5394

PRODUCTION METHODS

Ductile iron may be produced in the electric arc furnace, acid cupola, basic cupola, carbon lined (neutral) cupola or by duplexing from cupola to the electric arc furnace.

ELECTRIC ARC FURNACE

Because of the need for close metallurgical control and high purity analysis of the cast iron used as a base for ductile irons, a substantial number of foundries are now using the electric arc furnace for the same reasons that high quality steels have been made in this type furnace from the beginning.

It has been estimated that approximately one-third of the foundries making ductile irons are using electric furnaces in their operations.

It is now well established that, regardless of analysis, the ease of controlling slag-metal reactions and bath temperatures in the electric furnace make it an ideal tool for the production of close analysis products. The electric furnace not only provides for close chemical reduction and control but there is no further contamination of the bath because the "fuel" – electricity – contains no sulphur or other impurities.

Many foundries making precision ductile iron castings are employing the exceptional control features of the electric furnace in their operations. For example, there is great demand today for the electric furnace in producing Austenitic ductile irons, because, there are more alloys to control and pouring temperatures are more critical.

Some foundries practice duplexing in the electric furnace in conjunction with cupolas. As one foundryman stated, "It's the electric furnace hands-down for this operation." Any attempt to utilize oil or coal-fired holding furnaces would produce too much sulphur in the base metal.

A foundry manager, commenting on the electric furnace for producing ductile iron said, "It's wonderful . . . you can turn it on and off quickly and make up large or small heats as needed."

ACID OR BASIC CUPOLA

Through the years the conventional cupola with an acid lining has been operated purely as a melting furnace with no great chemical refinement expected. Cumulative sulphur absorption and declining raw material quality have made it increasingly difficult to meet the rigid and varied metallurgical specifications with the materials available and the chemical limitations of the acid cupola. The metallurgical requirements of ductile iron present a good example; with a magnesium addition, the final sulphur content of ductile iron will normally be below 0.020 per cent.

In the basic cupola, irons of 0.010 per cent sulphur and 3.90 per cent carbon are not uncommon. This iron requires approximately two-thirds the magnesium alloy addition usually needed for acid cupola iron. From the economic and metallurgical standpoint the basic cupola seems to offer more definite advantages than acid lined cupolas.

Look Ahead— Look Electric

Gives greatest flexibility—
Makes any steel—any time—from stainless to plain carbon. Handles cold scrap, metallics, hot metal. Starts, stops quickly — gives faster melts.

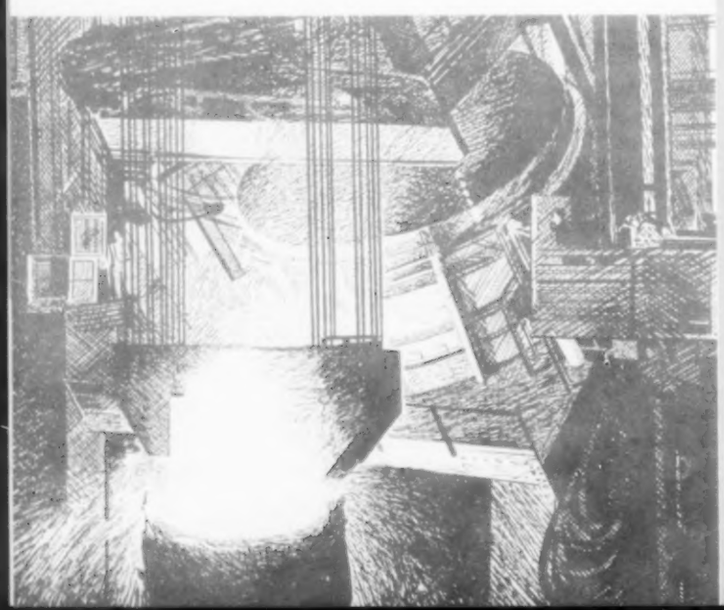
Delivers highest quality product—
Closer temperature control possible.

Lowers capital investment—
40% less than equivalent open-hearth capacity.

Saves space—
Savings of 25% and more vs. open hearths producing same tonnage.

Goes up fast—
Capital investment pays off sooner.

Uses clean fuel—electricity—
No combustion products to contaminate melt.



CARBON LINED CUPOLAS

Cupolas having carbon linings in the well area have proven superior in the production of ductile irons with respect to lining life and maintenance costs, and also assure close chemical and metallurgical control as required. The first installations of carbon linings were made by companies operating basic cupolas which had experienced high refractory costs due to the corrosive action of the basic slag. Full advantage has been taken of the high corrosion-resistant and chemically neutral properties of carbon. There are many cupolas operating in the United States today with "National" Carbon linings.

PRODUCTION TECHNIQUES

Due to the excellent fluidity characteristics of ductile iron in the molten state, thin sections cast as easily as thick sections. If thin section castings are desired, a charge of 100% pig iron will cast exceptionally well. But, the high carbon content of this molten metal (3.8 to 4.0%) will cause carbon flotation when cast in thick sections. Therefore, if thick section castings are on production schedules, operations will proceed much smoother when the charge is calculated to reduce carbon content of the base material to roughly 3.5 to 3.8 per cent. This can be accomplished by adding steel to the charge or better still, by employing the revert (gates and risers) from previous ductile iron castings, adding steel, and utilizing a carbon raiser in pellet form.

From tap-out to casting the process for ductile iron is similar regardless of the charge. The base metal is tapped into a ladle containing a magnesium alloy to provide a sufficient amount of retained magnesium necessary to promote spheroidal graphite. The bath is then inoculated with ferro-silicon to eliminate carbide and to insure metal will be graphitic when cast.

One source recommends that ductile base metal in the electric furnace should be heated to a minimum of 2850°F and held for ten minutes prior to tapping. It is easy to maintain close control at these temperatures in the electric furnace. This will assure a metal free of flake graphite and eliminate the risk of a poor heat.

CASTING AND FINISHING CHARACTERISTICS

Ductile iron is similar to soft, high carbon cast iron in that it has a low melting point and good fluidity in the molten state. Because of these characteristics it can be cast in intricate shapes and thin-sectioned parts. For example, the metal will flow several inches in sections as small as 1/16 in. in green sand molds at normal foundry pouring temperatures. Castings weighing but a few ounces contrast with others weighing as much as 50 tons to further verify the versatility of this new group of metals.

The machinability of ductile iron is superior to that of gray iron having the same hardness, with a considerable decrease in tearing. The millions of minute nodules of graphite provide a factor of self-lubrication which prevents galling and scuffing. It can be machined about twice as fast as steel at a considerably lower power requirement.

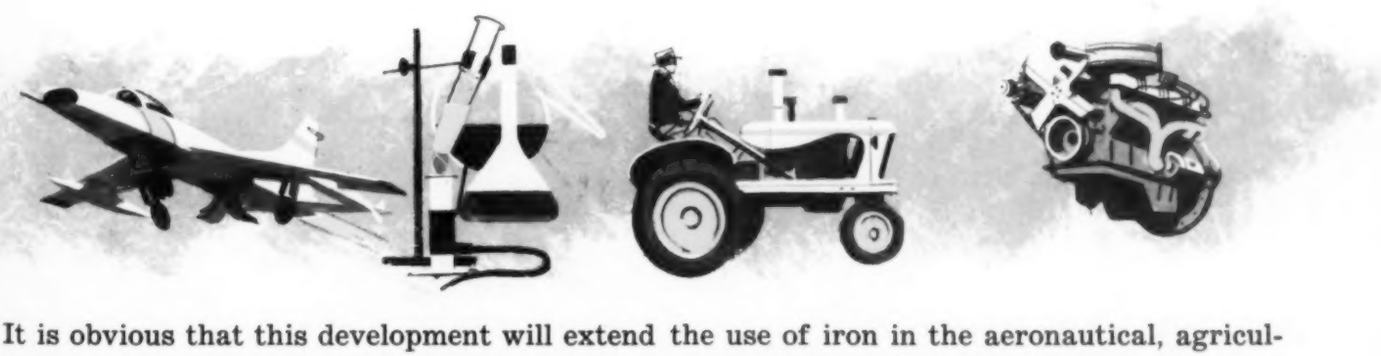
This new metal can be heat treated as readily and satisfactorily as steel. It can be softened by annealing or hardened by normalizing or oil quenching and tempering. Stress relieving of complex castings is a regular practice, while flame or induction hardening is accomplished without using special procedures, for all types except the high alloy types.

Ductile iron can be welded to itself and to other metals such as carbon steel, stainless steel, and nickel, using the same techniques as applied to good grades of gray iron. The material can also be brazed with silver or copper brazing alloys.

DUCTILE IRON APPLICATIONS

The characteristics of these irons suggest five general uses:

1. **Where greater strength or resistance to impact is needed than can be obtained with conventional cast irons.**
2. **For large castings which have been difficult to cast in malleable iron.**
3. **For replacing steel castings where higher yield strength, cost and machinability are factors.**
4. **Heat-resisting applications because of greater resistance to growth and high strength at elevated temperatures.**
5. **Pressure castings where close grain structure at low cost is a must.**



It is obvious that this development will extend the use of iron in the aeronautical, agricultural, automotive and diesel, cement, chemical processing, electrical, glass, heavy machinery, marine, mining, paper and pulp, petroleum, steel mill, tool and die, and many other industries.

The increasing use of this relatively new metal type is best proved by production figures showing that tonnages have increased approximately 100 percent in the past year.

The following listing represents most of the foundries now producing ductile iron in the electric arc furnace:

Centrifugal Casting Co., Long Beach, California
Stanley Foundries, Huntington Park, California
Farrell-Birmingham Co., Ansonia, Connecticut
Soundcast Co., Newport Beach, California
Howard Foundry Co., Chicago, Illinois
Sioux City Foundry & Boiler Co., Sioux City, Iowa
Crompton & Knowles Corp., Worcester, Massachusetts
Hunt-Spiller Mfg. Corp., Boston, Massachusetts
Baker Perkins, Inc., Saginaw, Michigan
Century Electric Co., St. Louis, Missouri
American Brake Shoe Co., Rochester, New York
Sterling Foundry Co., Wellington, Ohio
Textile Machine Works, Reading, Pennsylvania
Treadwell Engineering Co., Easton, Pennsylvania
Westinghouse Air Brake Co., Wilmerding, Pennsylvania
Westinghouse Electric Corp., Trafford, Pennsylvania
Standard Brass & Mfg. Co., Port Arthur, Texas
Fairbanks Morse & Co., Beloit, Wisconsin
Brown & Sharpe Mfg. Co., Providence, Rhode Island
Borg Warner Corp., York Division, York, Pennsylvania
Chapman Valve Co., Indian Orchard, Massachusetts
Clark Equipment Co., Buchanan, Michigan
Gleason Works, Rochester, New York
Ingersoll Rand Corp., Philipsburg, Pennsylvania
Engineering Castings Corp., Marshall, Michigan
Janney Cylinder Co., Philadelphia, Pennsylvania
Jeffrey Mfg. Co., Columbus, Ohio
Kiekhaefer Aeromarine Motors, Inc., Fond du Lac, Wisconsin
Koppers Co., Baltimore, Maryland
Penberthy Mfg. Co., Detroit, Michigan
Scott Castings Corp., Buffalo, New York
Thomas Foundries, Birmingham, Alabama
U. S. Pipe Co., Burlington, New Jersey
Wells Mfg. Co., Skokee, Illinois
Grede Foundries, Inc., Milwaukee, Wisconsin

SUMMING UP

That the uses of ductile irons are rapidly expanding there is no doubt. While it is difficult to approximate its economic impact on the producing and utilizing industries, its overall importance is now well established. There remains only a development of metallurgical refinements and production means and methods to assure its status as an equal member in our ever growing family of metals. For example, experimental work started in this country in September 1957, for adding pure magnesium to the base metal in sealed ladles. This technique . . . as well as other experimental work under way or presently planned – may point the way to greater economies in the manufacture of ductile iron.

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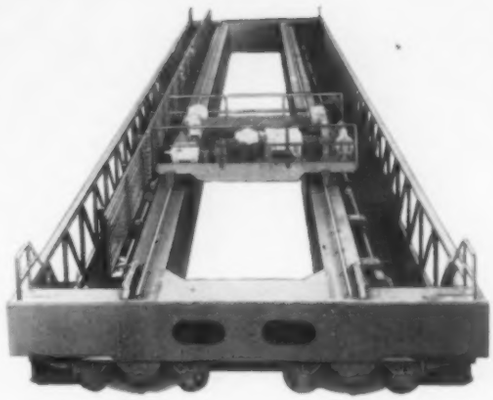
YOU NAME THE CRANE

"SHAW-BOX" WILL BUILD IT TO AISE SPECS OR YOUR OWN

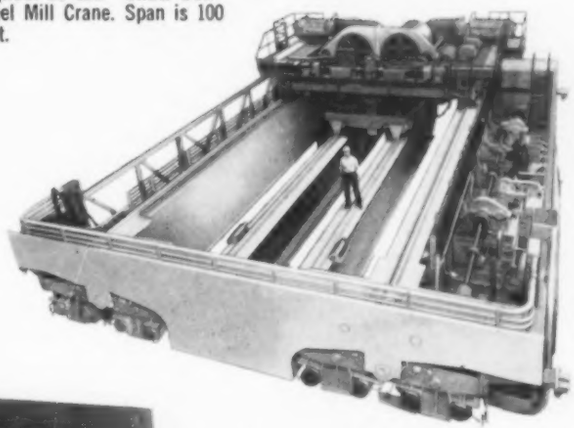
Ladle crane . . . plate or slab handling crane . . . trolley with worm-geared or spur-geared drive . . . soaking pit carriage — whatever your plans call for, "Shaw-Box" can be of service to you. In designing, engineering and building to AISE specifications or your own, we assure complete dependability and highest performance regardless of service conditions.

Mills everywhere have learned from experience that "Shaw-Box" know-how and vast production facilities save time, trouble and money. They know that "Shaw-Box" Cranes have many structural, mechanical and operational features that contribute to long-term satisfaction and economy.

One of our engineers will gladly discuss your specific problem and tell you about our standard AISE designs for cranes of 15 to 200-ton capacity. Your inquiry is invited.

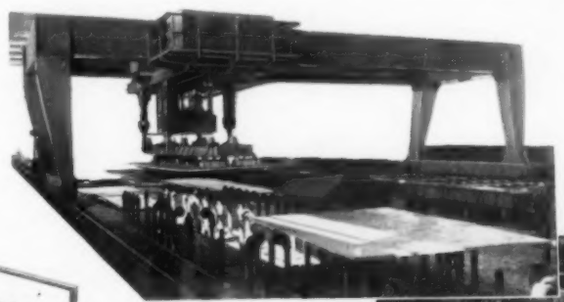


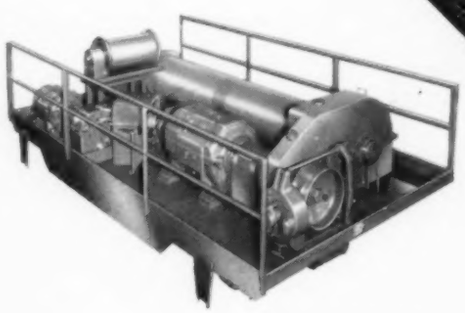
Typical 25-ton "Shaw-Box" Steel Mill Crane. Span is 100 feet.

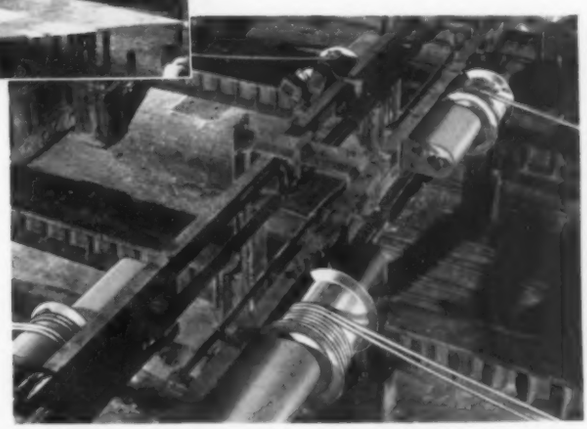


This "Shaw-Box" Ladle Crane handles 200 tons of molten steel in a 90-ton ladle.

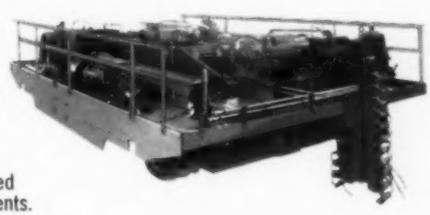
"Shaw-Box" Plate Handling Gantry equipped with lifting magnets.







"Shaw-Box" Soaking Pit Carriages. The special "Shaw-Box" Spring Drive Cable Reels have automatic limit switches to cut off current when the carriages reach the end of travel in each direction.



"Shaw-Box builds crane trolleys with spur-geared drive and with worm-geared drive. You can choose the type your experience has proved is most suitable for your requirements.

57K-5

MAXWELL MANNING M&M & MOORE INC. TRADE MARK

"Shaw-Box" ® CRANES

MANNING, MAXWELL & MOORE, INC.

SHAW-BOX CRANE & HOIST DIVISION

388 West Broadway • Muskegon, Michigan

Builders of "SHAW-BOX" and 'LOAD LIFTER' Cranes, 'BUDGIT' and 'LOAD LIFTER' Hoists and other lifting specialties. Other Divisions produce 'ASHCROFT' Gauges, 'HANCOCK' Valves, 'CONSOLIDATED' Safety and Relief Valves. 'AMERICAN' and 'AMERICAN-MICROSEN' Industrial Instruments, and Aircraft Products.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Avenue Road, Galt, Ontario.*

New Westinghouse All-Steel Panel for Mill Control

Non-breakable, easily installed, extra-safe DC mill control panel offers a new standard for steel mill performance

New all-steel d-c mill control panels will not break or crack under the most severe physical shock. At least 35 percent lighter in weight than other panel material, can be handled easier . . . installed faster.

Extra-safe, unbreakable, non-carbonizing insulating bushings have fiber glass base with alkyd resin blinder for greater shock resistance. Design gives ample creepage distances, superior anti-tracking qualities . . . prevents build-up of dust on bushing.

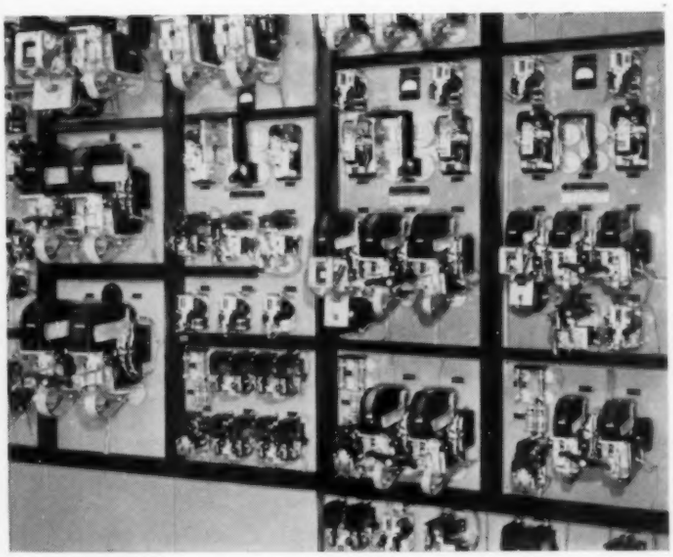
Control wiring in non-inflammable Micarta® channels with snap-off covers provides for easier wiring, tracing, inspection or repair. Stranded wire, highly resistant to vibration, is permanently marked with easy-to-read terminal marking.

Time-Proven Devices are heavy duty, rugged and liberally rated to give longer life for heavy steel mill service.

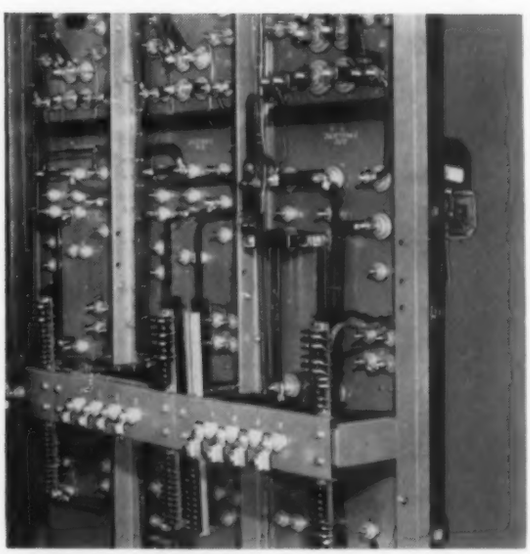
For more information about the new all-steel panel, call your Westinghouse sales engineer. Or write, Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pa.

J-22069

YOU CAN BE SURE...IF IT'S Westinghouse

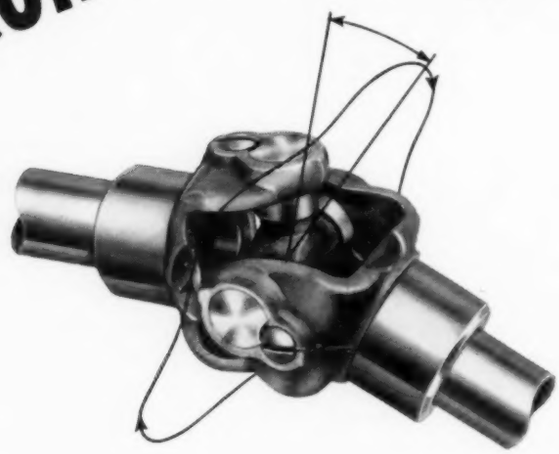


Bonderized light-grey finish of new Westinghouse all-steel panel brightens up entire control panel area — makes all external components easier to see, easier to inspect.

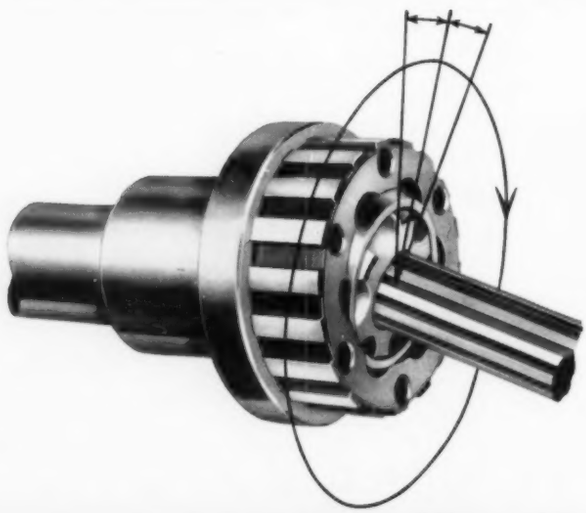


Maximum accessibility is offered with main connections in rear of new steel panel . . . gives more liberal spacing between leads since all control wiring has been removed from rear.

RZEPPA JOINTS ELIMINATE THE HIGH COST OF "Rock and Roll" Action...



Old-fashioned pin or slipper-type joints speed up, slow down twice during one revolution. What you get is rough and tumble "rock and roll" torque which cuts down joint life, causes vibration.



RZEPPA (PRONOUNCED "SHEPPA") CONSTANT VELOCITY JOINTS ELIMINATE THIS "ROCK AND ROLL" ACTION FOREVER!

Rzeppa Joints transmit 100% smooth torque every minute they are on the job. Operate precision smooth at angles up to 35°. No bounce. No chatter. No vibration. Long life and higher torque capacity are built into every Rzeppa Joint. You get longer shaft life, too.

RZEPPA ("SHEPPA") CONSTANT VELOCITY UNIVERSAL JOINTS

THE GEAR GRINDING MACHINE CO.

3929 Christopher, Detroit 11, Michigan

MANUFACTURERS OF: FULLY AUTOMATIC GEAR GRINDING MACHINES. DETROIT SCREWMATIC 750 SINGLE SPINDLE SCREW MACHINES.

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—or send us a dimensional sketch along with peak horsepower, operating angles and R. P. Ms. Our engineers will assist in making a proper joint recommendation.

this can be prevented.....

with *Statite*

and only USG® brushes have STATITE® permanent shunt connections

If you are having trouble with shunts jarring loose or being pulled out, we suggest you try USG Brushes with Statite. Statite is a permanent shunt connection needing no hammerclips. It can't be jarred out even under severe operating conditions, and will assure your electric motors of steady maintenance-free performance. Statite eliminates the need for riveted shunt connections. In addition, Statite shunt connections retain their original low millivolt shunt drop, cannot oxidize, and are unaffected by temperature extremes. USG Brushes are manufactured in a variety of types and sizes for all applications from fractional horsepower to diesel generator. Grades available include carbon and carbon-graphite, electrographitic, graphite, metal graphite, and silver graphite.

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SEND THE ATTACHED COUPON . . . for Engineering Handbook B-56 and Brush Grade Supplement.

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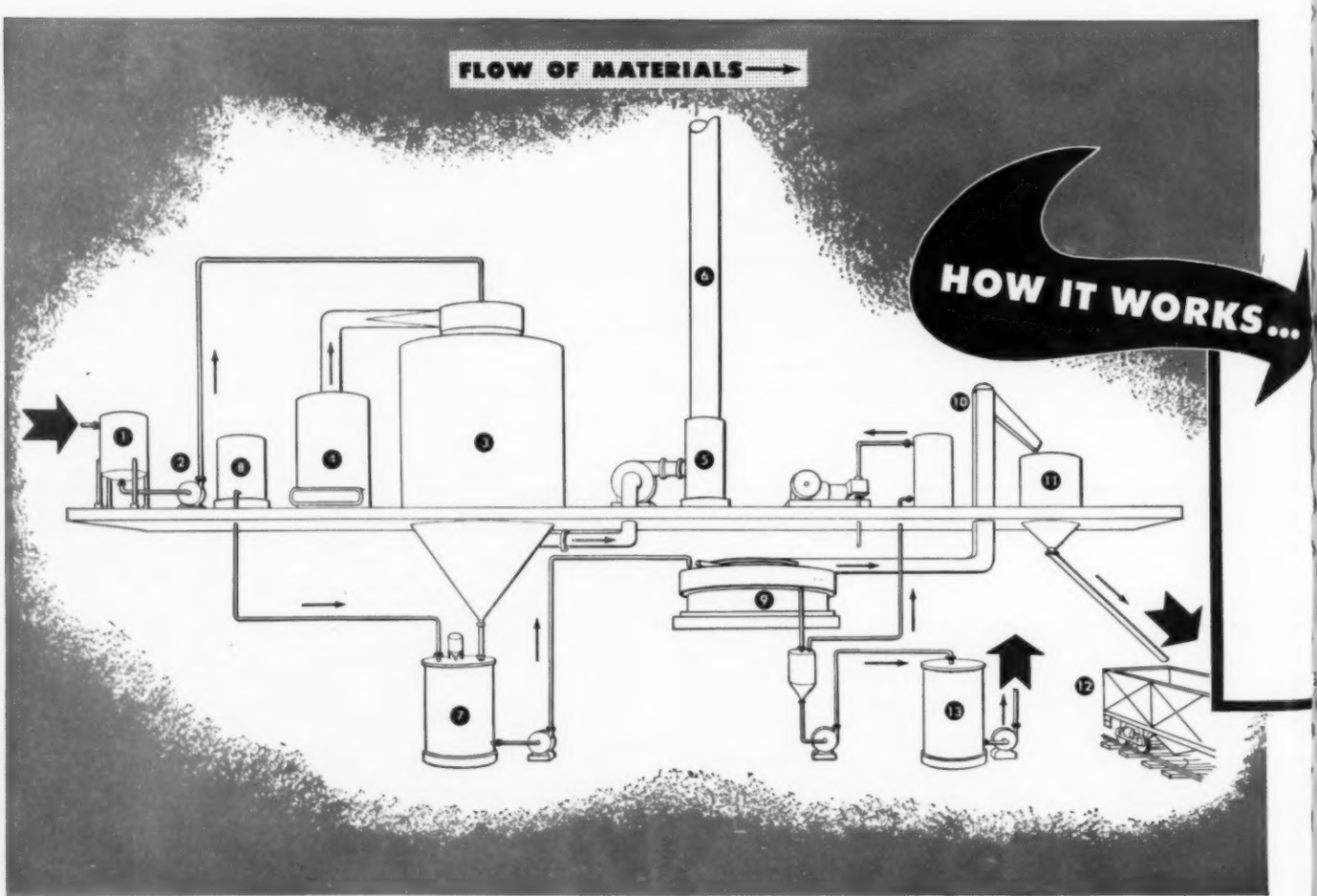
If you operate a CUT ACID REQUIREMENTS

New continuous process, available from Koppers, of pickling acid used . . . and eliminates waste

FOR OVER A QUARTER OF A CENTURY, wherever a pickling line has been in operation, disposal of spent liquor has been a major headache. But now a new continuous regeneration process—the Koppers Inland-Zahn process— goes a long way toward solving this problem. This system is simple, it is economical, and *it has been proved in actual plant-scale commercial operation in Europe.*

With this process, the only make-up acid needed is the amount consumed in the pickling reaction plus normal losses. *All* available free acid in the used liquor is recovered (up to 50% of the original charge). Labor costs are low—just one man can operate the entire regeneration plant. As a result of these savings, operating costs are substantially below those of any presently available disposal method.



pickling line

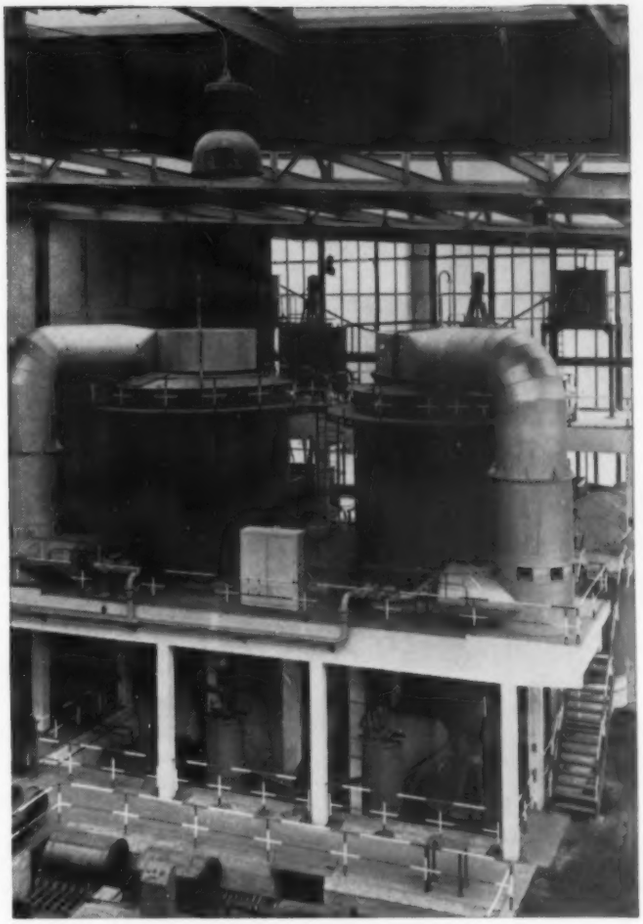
IN HALF!

regenerates up to half liquor disposal problem

PROVED COMMERCIALLY—This process, developed by Inland Steel Company and adapted commercially by Zahn & Co. of West Germany, is now being used successfully in three European steel plants. The benefits achieved include *extremely low maintenance* . . . and more uniform and *higher* acid concentrations in the baths. The latter advantage permits faster steel processing.

NEUTRALIZING PLANTS – The new regeneration process is especially applicable to plants handling 10,000 gallons of effluent, or more, a day. The Chemical Department of Koppers Engineering and Construction Division also designs and builds lime neutralization systems for both large and small pickling operations. Send the coupon for complete information about these and other Koppers Chemical Engineering Services.

Spent pickle liquor (1) is pumped (2) to spray head in an evaporating chamber (3). Here, hot air and flue gases from a combustion chamber (4) concentrate the liquor and cause the ferrous sulfate monohydrate to crystallize out of solution. Vapor laden air is discharged to atmosphere through a mist eliminator and stack (5 and 6). The slurry is dropped into a crystallizing tank (7) where fresh sulfuric acid is added from a metering tank (8). This causes more monohydrate to drop out. The slurry is then separated in a vacuum filter (9) and washed. Salt is conveyed to bins or hopper cars for sale or disposal (10, 11, 12). Mother liquor, containing about 35% acid and 1-2% iron, is pumped to a holding tank (13), ready for dilution and return to the pickling tanks. No reheating is required.



HEART OF THE SYSTEM—This spray dryer concentrates spent liquor to slurry of ferrous sulfate monohydrate crystals suspended in acid. The plant shown here, in Germany, has operated since June, 1954, processing 48,000 gallons per day of waste liquor.

GET ALL THE FACTS!

Koppers Company, Inc.
Engineering and Construction Division
1451 Koppers Building
Pittsburgh 19, Pennsylvania

I would like to receive literature on this new pickle liquor regeneration process . . . and also on Koppers other chemical engineering services. Please send the following:

- ☐ **Regeneration of steel pickling solutions by Koppers Inland-Zahn process.**
- ☐ **Lime neutralization of spent pickle liquor by Koppers.**
- ☐ **"3 Keys to Selecting Your Industrial Contractor," a brochure describing the variety of Koppers construction services and giving reasons why Koppers should build your next chemical plant.**

Name_____

Title_____

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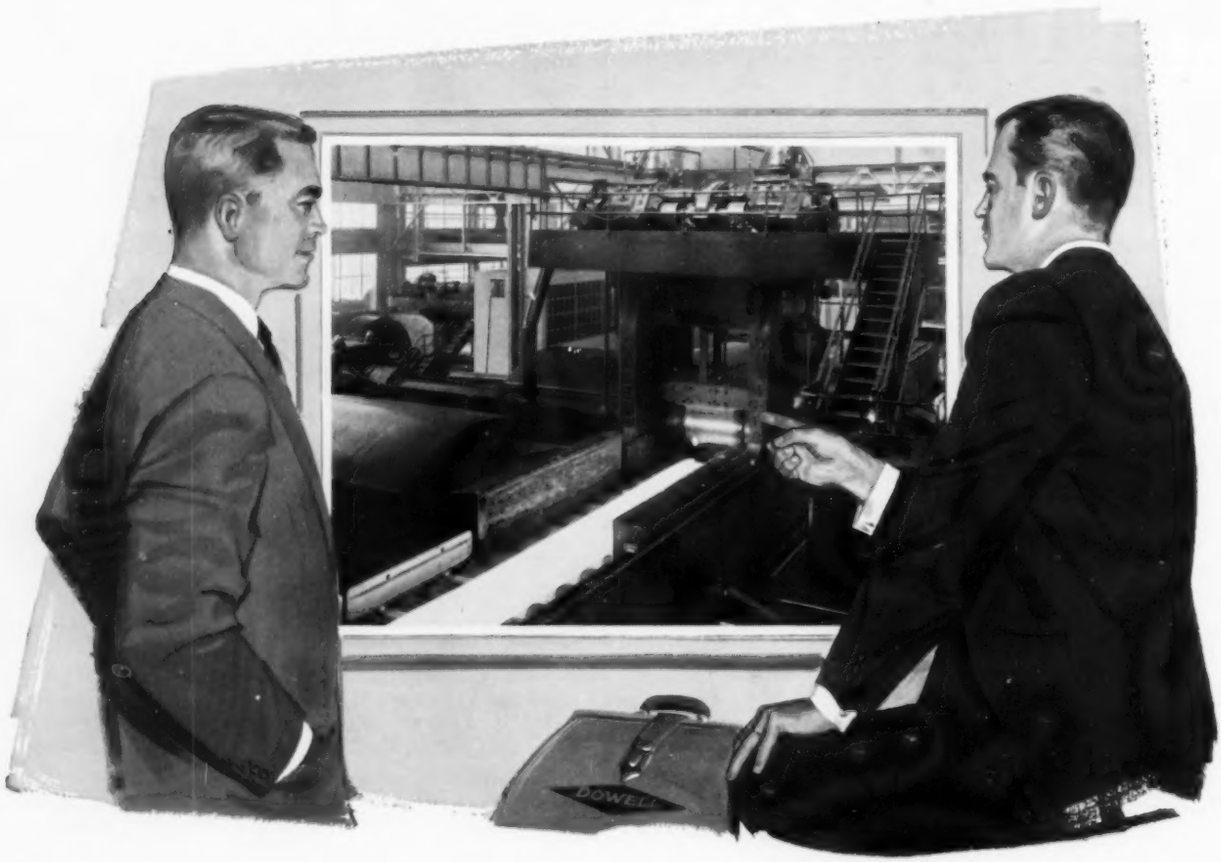
KOPPERS

KOPPERS

CHEMICAL ENGINEERING SERVICES

A $250,000 operating credit made possible by Dowell mill scale removal service!



This operating credit was made possible when Dowell chemically cleaned a steel company's new rolling mill before it was put into operation. By removing mill scale thoroughly, Dowell Service prevented any major, emergency shut-down caused by scored bearings or fouled lines and valves. This netted the company an estimated $250,000 operating credit.

Following the erection of this new 45 x 80, 2-high slab mill, Dowell was called in to remove mill scale and degrease the lube oil system, hydraulic and air lines, hydraulic systems for the roll changer and vertical edger, and the Bowser lube oil systems in the main motor room.

The job was accomplished in about one-half the time it would have taken the steel company to do the work itself. The cost of Dowell Service was only $21,000.

In addition to reducing the risk of mill-scale fouling, Dowell Service eliminated the costly process of prepickling or batch pickling the pipe used in the hydraulic, lube oil and air line systems.

Dowell chemical cleaning service has made possible similar savings for many companies in other industries — such as chemical, refining, paper, and the public utilities. That's because Dowell engineers are experts in the use of solvents to remove scale and sludge from process equipment, tanks, piping and lines. Dowell furnishes all the necessary chemicals, trained personnel, pumping and control equipment.

For specific information on how chemical cleaning can help you to greater profits, call the Dowell office near you. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

have Dowell clean it chemically **DOWELL**

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Date-line Diary...

September 3

▲ Shipments of iron and steel castings during June, 1957 amounted to 1,284,667 short tons compared with 1,353,175 short tons in May, 1957 and 1,392,452 short tons in June, 1956. Shipments in July, 1957 amounted to 1,133,868 compared with 934,935 tons in July, 1956.

▲ The AISI reports that the operating rate of the steel industry for the week of September 2 is scheduled at 82.7 per cent of capacity. This is equivalent to 2,116,000 tons compared with 2,103,000 tons one week ago and 2,429,000 tons one year ago. Index of production for the week is 131.7.

September 4

▲ Copper prices further declined with major U. S. producers quoting at 27¢ per lb, down 1½¢; custom smeleters lowered their prices ½¢ to 26½¢; spot copper in London dropped to 24⅞¢.

▲ According to the AISI, estimated payroll for the iron and steel industry for July, 1957, amounted to $334,600,000 compared with $324,823,000 during June, 1957, estimated total employment was 665,300, compared with 666,400 in June. Average hourly payroll cost per wage earner was $2.983, a new record compared with June cost of $2.862. Average hours worked a week was 34.8 compared with 36.7 hours in June.

September 5

▲ The Aluminum Assn. reports net shipments of aluminum sheet and plate in July, 1957, equalled 119,226,000 lb compared with 105,927,000 lb in June, 1957; shipments of aluminum foil totaled 15,001,369 lb in July, 1957, compared with 12,707,834 lb in June, 1957.

▲ H. Y. Bassett, president, Calumet & Hecla, Inc., disclosed that the company was considering a complete shutdown of their operations in Michigan since they are losing money as a result of declining copper prices.

▲ The Commerce Dept. reported that manufacturers sales in July rose three per cent over the June rate, and inventories of manufacturing firms expanded $300,000,000 during July.

▲ Jones & Laughlin Steel Corp. is currently negotiating the purchase of the Geuder, Paeschke & Frey Co. plant at Milwaukee, Wis., manufacturers of galvanized wash tubs, buckets, etc.

▲ U. S. Steel Corp. announced that current prices on tin coated steel, which goes mostly into containers, will be continued through December 31. Present sales contracts expire November 1. On January 1, 1958, the company will adopt a new policy whereby prices on tin plate can be changed on 35 days' notice instead of being set semi-annually as now exists.

September 9

▲ The AISI reports that the operating rate of the steel industry for the week of September 9 is scheduled at 83.1 per cent of capacity. This is equivalent to 2,126,000 tons compared with 2,073,000 tons one week ago and 2,477,000 tons one year ago. Index of production for the week is 132.3.

September 11

▲ The Government cut its estimate of business spending for new plant and equipment during the third quarter from an annual rate of $37,900,000,000 to $37,200,000,000, and predicted fourth quarter outlays at the same pace.

▲ The Labor and Commerce departments reported that employment in mid-August amounted to 66,400,000, down 800,000 from July, and 400,000 under the August, 1956, total.

September 12

▲ The AISI reports that production of steel for the first eight months of 1956 exceeded all previous production for this identical period, totaling 78,710,279 net tons of ingots and steel for castings. Steelmaking furnaces were operated at an average of 88.6 per cent of January 1, 1957, capacity (133,569,150 net tons annually).

September 13

▲ The Labor Dept. reported that home building starts in August rose to a seasonally adjusted annual rate of 1,010,000 units, compared with a pace of 980,000 in July, and 1,136,000 rate in August, 1956.

▲ Federal judge approves reorganization plan for Northeastern Steel whereby Carpenter Steel will take over the plant, subject to approval by Northeastern creditors and security holders affected by the plan. The setup calls for an exchange of an estimated 40,000 of Carpenter's shares for about 1,000,000 shares of new Northeastern stock. This Carpenter stock will be distributed to general creditors and debenture holders, and $6,000,000 of first mortgage, 4½ per cent bonds, due February 1, 1970, will remain outstanding as a first lien on the property after the reorganization is completed and expenses paid.

▲ Youngstown Sheet plant at East Chicago was closed by a 200-man unauthorized walkout over work schedules dispute. Since the strike was unauthorized the company refused to negotiate the dispute until the employees return.

September 16

▲ A strike of about 150 crane operators, idling about 3000 steelworkers, at Republic Steel's Gadsden plant ended when the union agreed to handle a dispute over working conditions through the regular grievance procedure.

▲ The American Can Co. reported that production of metal cans by the industry for the first half of 1957 totaled 18,700,000,000, compared with just over 19,000,000,000 in 1956.

▲ The AISI reports that the operating rate of the steel industry for the week of September 16 is scheduled at 81.1 per cent of capacity. This is equivalent to 2,076,000 tons compared with 2,097,000 tons one week ago and 2,477,000 tons one year ago. Index of production for the week is 129.2.

▲ Bethlehem Steel and Youngstown Sheet and Tube filed affidavits in Federal court, Southern District of New York showing why their merger will not reduce competition in the steel industry.

▲ The Boards of Directors of Copperweld Steel Co. and Superior Steel Corp. formally approved a joint

merger under which Superior will merge into Copperweld, to be effected by the issue of ¾ share of Copperweld common in exchange for each share of Superior common. Stockholders of both companies are to hold meetings on November 8 in Pittsburgh to vote on the merger.

September 17

▲ Arthur B. Homer, president of Bethlehem Steel, disclosed that the company plans to spend $358,000,000 in expanding Youngstown Sheet and Tube's capacity if the merger of the two companies is approved, of this $268,000,000 would be expended on Youngstown's facilities in the Chicago district.

September 18

▲ The Commerce Dept. reported that personal income in August, 1957, rose to a rate of $347,300,000,000 annually on a seasonally adjusted basis, over $1,000,000,000 higher than the July, 1957, pace.

▲ The Bureau of Mines reported that the consumption of scrap during July, 1957, totaled 4,898,000 gross tons and pig iron 5,559,000 gross tons compared with 5,430,607 tons of scrap and 5,672,086 tons of pig iron in June, 1957.

September 19

▲ A $20,000,000 program for improvements to primary mill facilities at the Midland works has been approved by the board of directors of the Crucible Steel Company of America. The program consists of the purchase and installation of a new electrically driven blooming and slabbing mill, modification to the hot strip mill, as well as additions and improvements in slab heating and other auxiliary equipment.

▲ The ARCI reports that deliveries of new domestic freight cars in August, 1957, totaled 8758 compared with 7725 in July, 1957, and 5364 in August, 1956. Orders totaled 3203 compared with 1251 in July, 1957 and 2575 in August, 1956. Backlog of cars on order as of September 1 stood at 79,258 cars.

▲ The Aluminum Assn. reported primary aluminum production in the United States during August, 1957, was 143,448 short tons compared with 142,157 short tons in July, 1957, and 92,406 tons in August, 1956.

▲ Texas Gulf Sulphur Co. reduced sulphur prices $2.50 to $3.00 a ton, other large sulphur concerns have stated they will probably have to follow suit.

September 20

▲ Texas' state authorities set the October allowable production at 2,964,062 barrels a day, down 228,075 barrels, restricting most Texas wells to 12 days operation, compared with 13 days in July, August, September.

▲ Electro Metallurgical Co., Div. of Union Carbide Co., posted price advances, effective October 1. High-carbon ferrochrome is being increased one cent per lb of contained chromium; low-carbon ferrochrome will be increased 2¢ per lb of chromium; the price of 50 per cent ferrosilicon is up 1.2¢ per lb of contained silicon. At the same time the company announced a reduction of ½¢ a lb, across the board, in the price for standard ferromanganese. The new base price becomes 12¼¢ a lb of material.

September 23

▲ The AISI reports that the operating rate of the steel industry for the week of September 23 is scheduled at 82.5 per cent of capacity. This is equivalent to 2,112,000 tons compared with 2,101,000 tons one week ago and 2,502,000 tons one year ago. Index of production for the week is 131.5.

▲ Industrial Heating Equipment Assn. reports that new orders for industrial furnaces in August, 1957, were $3,924,000, compared with $6,722,000 in August, 1956; orders for induction and dielectric heating equipment in August were $1,350,000 compared with $1,030,000 in August, 1956.

▲ Agriculture Secretary Benson announced the government will pay farmers $1.10 a bushel for corn grown in defiance of federal acreage curbs contending that the so-called non-compliance support is necessary to help prevent the collapse in grain marketing now and hog markets later.

September 25

▲ Reynolds Metals Co. and Esso Standard Oil Co. signed a year's contract for 35,000,000 to 60,000,000 aluminum quart size motor oil cans. Reynolds will supply aluminum sheet metal and cans will be fabricated by American Can Co. and Crown Cork & Seal Co.

▲ The Bureau of Labor Statistics' index of consumer prices in August, 1957, advanced 0.2 per cent to 121 per cent of the 1947–49 average, an advance of 3.6 per cent over the August, 1956, level. Food prices rose 0.4 per cent to a record 117.9 per cent.

▲ Imports into the U. S. in July amounted to $1,144,700,000, 16 per cent over June, 1957 and 9 per cent over July, 1956.

▲ Steel scrap prices fell sharply in the Pittsburgh area, down $11 to $12 a ton to prices of $46 to $47.50 for No. 1 industrial bundles.

▲ The AISC reports that shipments of fabricated structural steel for August, 1957, were 333,133 tons compared with 303,512 tons in July, 1957, and 213,495 tons in August, 1956; bookings for August totaled 167,083 tons compared with 202,772 tons in July, 1957, and 268,273 tons in August, 1956. Backlog on August 31 equaled 2,962,000 tons, approximately 4 per cent under a year ago.

September 26

▲ A 2-day old wildcat strike of more than 1600 workers at TC&I Div. of U. S. Steel Corp. stemmed from the company's installation of semi-automatic, power-operated machines which resulted in relocation of personnel and duties but no layoffs. Mines are affected.

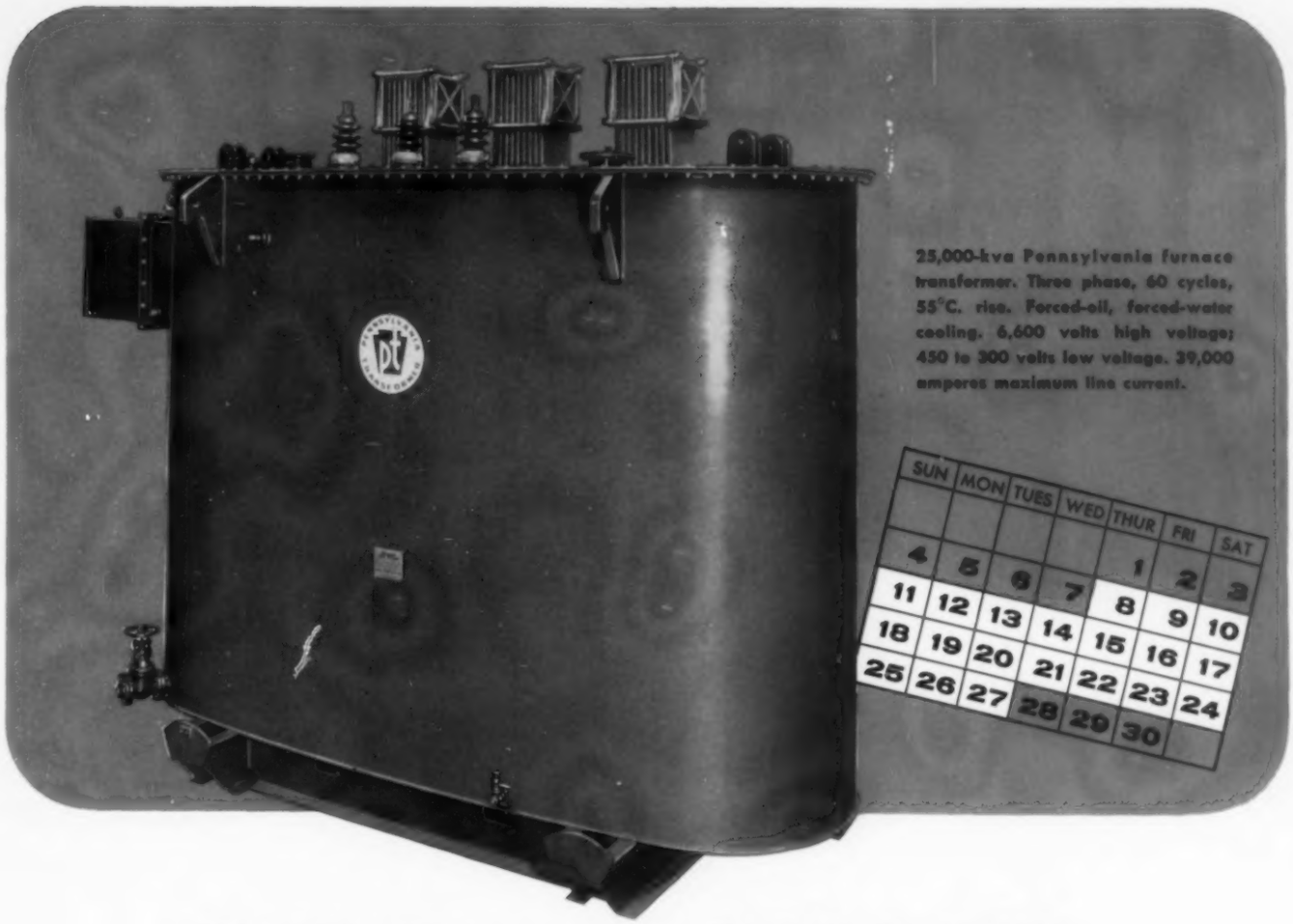
▲ Some 2000 workers who continued a wildcat strike, which both the company and union officials claim is unauthorized, after the deadline to return to work, were fired by the Lone Star Steel Co. The issues causing the strike are not clear, the chief complaint is that too many grievances are taken into arbitration by the company and the strikers contend this is time consuming and costly to their union local.

September 27

▲ National Machine Tool Builders Assn. reports that new orders for August, 1957, totaled $44,650,000 compared with $55,500,000 in July, 1957, and $87,500,000 in August, 1956.

September 30

▲ The AISI reports that the operating rate of the steel industry for the week of September 30 is scheduled at 82.4 per cent of capacity. This is equivalent to 2,108,000 tons compared with 2,105,000 tons one week ago and 2,506,000 tons one year ago. Index of production for the week is 131.2.



25,000-kva Pennsylvania furnace transformer. Three phase, 60 cycles, 55°C. rise. Forced-oil, forced-water cooling. 6,600 volts high voltage; 450 to 300 volts low voltage. 39,000 amperes maximum line current.

BUILT and SHIPPED in *20 Calendar Days!*

25,000 KVA FURNACE TRANSFORMER

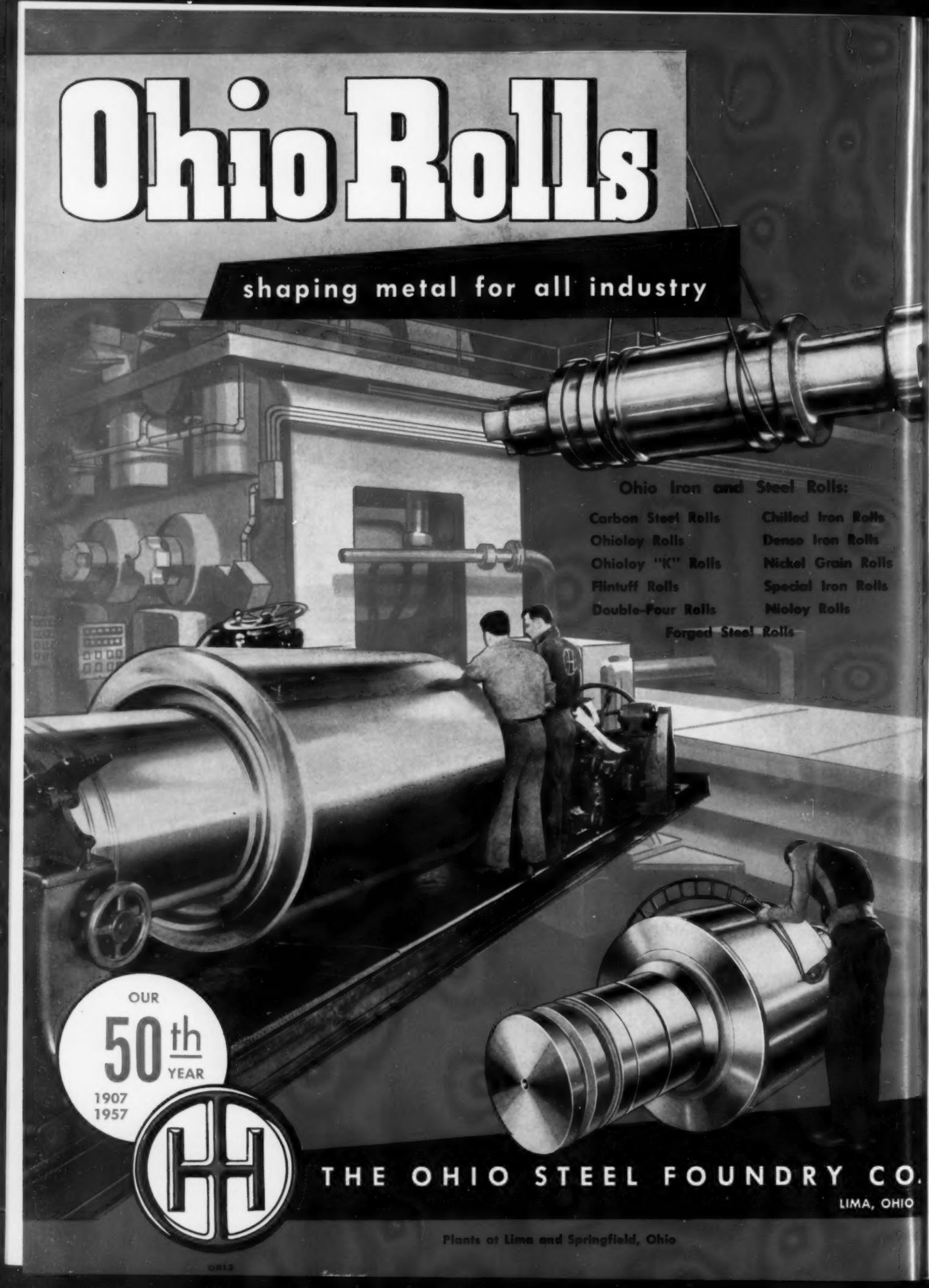
by Pennsylvania

Even the *promised* shipping date of four weeks looked like excellent service to the West Coast steelmaker — and yet Pennsylvania was able to cut the allotted production time by more than one-fourth! As a result, the electric steel furnace for which this 25,000-kva replacement unit was built was put back into service even sooner than expected, and several days of costly downtime were averted.

Throughout the years, Pennsylvania Transformer has established a nation-wide reputation for tackling — and solving — the most difficult transformer problems, whether they involve short-time delivery or special design requirements. Particularly in the highly demanding furnace transformer field has this been true. Only recently Pennsylvania designed and built a record-breaking 82,000-ampere unit . . . and more than once have furnace transformers with special requirements been designed, built and shipped in less than two months.

Of course it takes a lot of "everyday" know-how to accomplish the unusual, and Pennsylvania has designed and built virtually every size and type of furnace transformer now in use: from 250 through 25,000 kva, and from 3175 through 82,000 amperes. Why not put this furnace transformer experience to work for you? Pennsylvania Transformer Company, A McGraw-Edison Company Division, Canonsburg, Pa.

PENNSYLVANIA PENNSYLVANIA pt TRANSFORMER **FURNACE TRANSFORMERS**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Industry News...

INLAND TO HIKE WIDE FLANGE BEAM OUTPUT

▲ Inland Steel Co. has announced a multi-million dollar expansion program that will double its output of wide flange beams. Joseph L. Block, president, said directors had authorized a program, scheduled to be completed in the first half of 1959, which will lift capacity for this type beam to 54,000 tons a month. He also disclosed that when the new beam capacity is installed, Inland will discontinue the manufacture of steel rails.

The company began production of wide flange beams late in 1955 by making alterations and additions to its structural shape and rail mill originally built in 1917. Facilities initially designed to include 14,000 tons of the beams a month along with other products have actually been producing at a rate of 22,000 to 28,000 tons a month, Mr. Block said.

In his announcement, he said, "Our studies indicate that there is an excess of capacity in the country for rail production now and in the foreseeable future. The reverse is true in respect to wide flange structural steel beams. There has been a severe shortage, and the estimated requirements in the future indicate continued growth.

RELINED BLAST FURNACE IS BACK IN OPERATION

▲ Blast Furnace "A" at the Neville Island works of the Pittsburgh Coke & Chemical Co. was blown in September 11 after complete relining and installation of new equipment.

Besides relining, the furnace has been adapted to permit production of standard ferromanganese in addition to pig iron, according to C. T. Marshall, general manager of the firm's Coke and Iron Division.

The furnace's stove capacity was also increased 30 per cent since ferromanganese requires higher blast heats than conventional pig iron, he said. In addition, a specialized gas cleaning system, designed by Pittsburgh Coke engineers, was installed. Mr. Marshall noted that the company expects the completely new system to materially aid its stream and air pollution abatement efforts.

The project also included installation of new stove burners, additional rows of stack cooling plates, a hot blast mixer system, and new slag handling equipment. Koppers Engineering and Construction Division was the prime contractor.

The furnace, one of two at Neville Island operated by the Coke and Iron Division of PC&C has been out of blast since June 21. It has a daily production of 900 tons of pig iron.

Pittsburgh Coke will now be one of four companies in the nation to produce ferromanganese by the blast furnace method. A major supplier of the nation's foundries, the company produces merchant pig iron in all grades: basic, malleable, foundry, bessemer, and intermediate low phosphorus.

YS&T SEAMLESS TUBE MILL NOW OPERATING

▲ Operations have begun at the Youngstown Sheet and Tube Co.'s new seamless tube mill at Indiana Harbor Works.

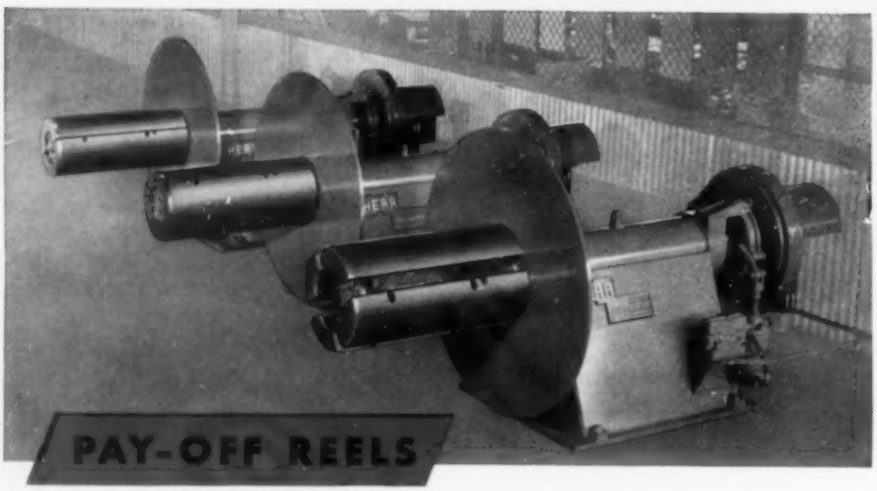
The new mill is the latest step in a continuing expansion program at Indiana Harbor, and is the first seamless operation installed there. The company formerly made all its

NEW DOCK SERVES PITTSBURGH DISTRICT MILLS

Scrap metal for Pittsburgh district steel mills arrives at this new 1065-ft-long dock at Bunola, Pa., built by Dravo Corp. for Monongahela River Terminals Corp. The dock, consisting of 11 sheet steel pile cells filled with sand and gravel and topped with concrete, is part of a new rail-river terminal 26 miles upstream from Pittsburgh on the Monongahela River. Central 30-ft-diam cell supports an electric revolving crane equipped with either magnet or bucket for loading and unloading barges. Top of cells rise 25 ft above normal pool. In addition to building a dock, Dravo dredged 40,000 cu yd of material from the river bottom to provide a harbor. The terminal is also equipped with railroad scales and crane equipment to store bulk storage materials.

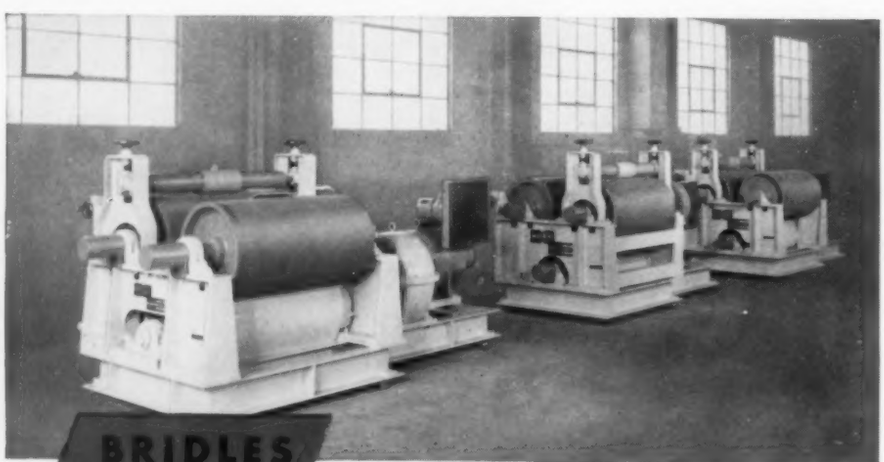
HERR EQUIPMENT

"Complete Processing and Handling Equipment . . . for any Ferrous or Non-Ferrous Material . . . That Starts — or Ends — as a Coil"



PAY-OFF REELS

Types and sizes for coils weighing from 5,000 to 50,000 lbs. and up to 84" wide. Fixed, adjustable or automatically aligning bases. Timken bearings. Can be equipped with threading drive, also automatic speed compensating drive for feeding presses.



BRIDLES

Types and sizes to meet any requirement. Plain steel, rubber covered or "Lorig" type self-aligning rolls. Air operated or regenerative brakes. Also four roll type that permits pay-off and coiling reels to be placed at the same end of the line and controlled with a single operator.

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THE HERR EQUIPMENT CORPORATION

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CLEVELAND, INDIANAPOLIS AND BERKELEY, CALIFORNIA

seamless pipe at Youngstown, Ohio.

The new mill features a giant rotary furnace which will be used to heat billets before they are fed into the piercing mill. It is capable of handling a larger tonnage of billets than any rotary furnace ever before built.

As many as 200 billets may be in the hearth at one time. The furnace is designed to handle a maximum production of 210 billets per hour, heated to a temperature of 2200 deg.

TIMKEN WILL INSTALL NEW VACUUM FURNACE

▲ The Timken Roller Bearing Co.'s board of directors has appropriated $500,000 for the purpose of installing a consumable electrode vacuum electric furnace. The furnace will be located immediately north of the present melt shop, and will be incorporated with it by extending the charging section of the melt shop building an additional 63 ft. Capacity of the furnace will be 5,000,000 lb per year or approximately 200 tons per month. Twenty-four in. ingots can be produced by the new furnace.

John Fick, vice president of the Timken Co.'s Steel and Tube Division said that the new vacuum furnace will produce a cleaner, sounder steel with very high fatigue strength, and ductility. Steel produced from the vacuum furnace will make it possible to melt improved quality steel in sufficient quantity for use in higher stressed bearing applications, making possible a much longer bearing life. Steel suitable for vital aircraft parts and for use in the guided missile program will also be produced in the new furnace.

Construction of the building to house the new furnace, and its subsequent installation will require from eight to nine months, with June 1, 1958, set as a target date for completion.

UCA PLANT READIED FOR FULL OPERATIONS

▲ Manufacturing operations are scheduled to begin this month in the new ferroalloy plant built by Vanadium Corp. of America in the Ohio Valley, near Steubenville.

Nine buildings have been erected. The larger buildings have furnaces and casting equipment. Adjoining each production building is a sepa-

Save by using specialized refractories

Many refractories problems in metal-working furnaces have been solved *economically* by the use of B&W specialized refractory castables. Each ferrous or non-ferrous furnace application requires a specific combination of properties to meet the service conditions. Whether your problem is high temperatures, abrasion and erosion, slag attack or the need for insulation, to name a few, you will find the refractory castable best suited to your requirements in B&W's line. Shown here in digest form are data on the widely used B&W refractory castables for metal-working furnaces:

B&W Refractory Castables for Metal Working Furnaces

	Temp. F	PROPERTIES	TYPICAL APPLICATIONS
B&W Kaocast	3000	High resistance to spalling and slag attack. Low volume change and negligible reheat shrinkage.	Soaking pit covers, linings of high temperature heating and forging furnaces, burner blocks, electrode linings of electric furnace roofs, linings of non-ferrous metal furnaces.
B&W Kaocrete 32	3200	High strength, exceptional refractoriness, unusual volume stability, excellent resistance to spalling.	Can be used in applications similar to those of B&W Kaocast and where higher refractoriness is required.
B&W Kaocrete D	2500	Sufficient strength and hardness to withstand abrasion, considerable physical abuse and erosion.	Aluminum melting furnaces, linings and car tops in heat treating furnaces, as well as in sections of a wide variety of furnaces that are subject to scraping by hand tools or other mechanical abuse.
B&W Kaocrete A	2600	Resists reducing atmospheres. Has good resistance to erosion, abrasion and thermal shock.	Annealing furnace bases and other applications where resistance to reducing atmospheres is essential. Also as a general purpose castable for linings in medium temperature service.
B&W Kaocrete B	2300	Has an adhesive plastic texture particularly suited for vertical or overhanging constructions. Excellent for plastering.	Patching linings and baffles and for any application where plastering rather than gunning or casting is required.
B&W Kaocrete LI	2700	High alumina content, exceptionally high strength for resistance to abrasion and erosion.	Aluminum furnace linings where high alumina content is important.
B&W Kaolite 20	2000	Offers castable's fast, low cost installation plus insulation. Has refractoriness, light weight and low heat conductivity and, in addition, will resist reducing atmospheres. Can be poured or gunned.	Aluminum melting, heating and heat-treating, annealing and forge furnaces. Also for general maintenance and patching.
B&W Kaolite 22	2200	Has the same properties as B&W Kaolite 20. Can be used for higher temperatures but not in reducing atmospheres.	

Send for your copy of B&W Bulletin R-35. It gives additional information on B&W's versatile refractory castables.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide

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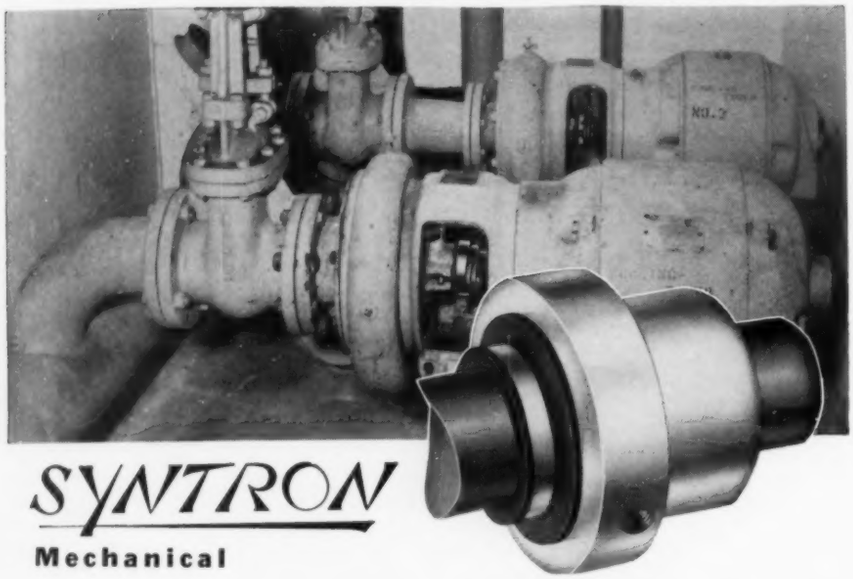

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Syntron Shaft Seals are successfully handling difficult liquids and gases. They provide a positive-leakproof seal around rotating shafts for long periods without maintenance or adjustment.

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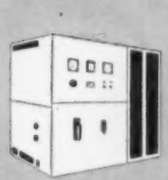

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rate products preparation and shipping building. This functional separation divorces hot metal processing from the cleaner packing and shipping operations.

Other buildings house plant offices, laboratories, metallic reclamation operations, power substation and water treatment and service facilities.

Five large electric arc furnaces are installed in the larger of the furnace buildings. Begun in April, 1956, this unit will produce low carbon ferrochromium alloys.

The second furnace building, started in December, 1956, houses three electric arc furnaces producing high carbon ferrochromium and ferrochrome-silicon alloys.

Furnaces in the new plant are of unique design developed for ferroalloy production of VCA engineers. The hooded tops of these furnaces restrict the radiation of heat and provide for complete removal of fumes from the working areas. This design also results in more efficient utilization of heat, electric energy and raw materials.

Contemplated for later construction is a third unit of the plant which will manufacture manganese alloys.

REFRACTORIES FIRM ADDS NEW RESEARCH CENTER

▲ Construction of an integrated modern research center was begun by Harbison-Walker Refractories Co. on a 21-acre suburban site south of Pittsburgh, Pa. When completed next year, the million dollar project will house all of the company's research activities. The research center will provide expanded facilities and staff for the study of highly refractory materials and the development of processes for converting them into industrial products. Ample provision is being made for future expansion.

The research center, having total floor space of 45,000 sq ft, will be comprised of two major structures connected by a reception area—a fine instruments building and a pilot plant building.

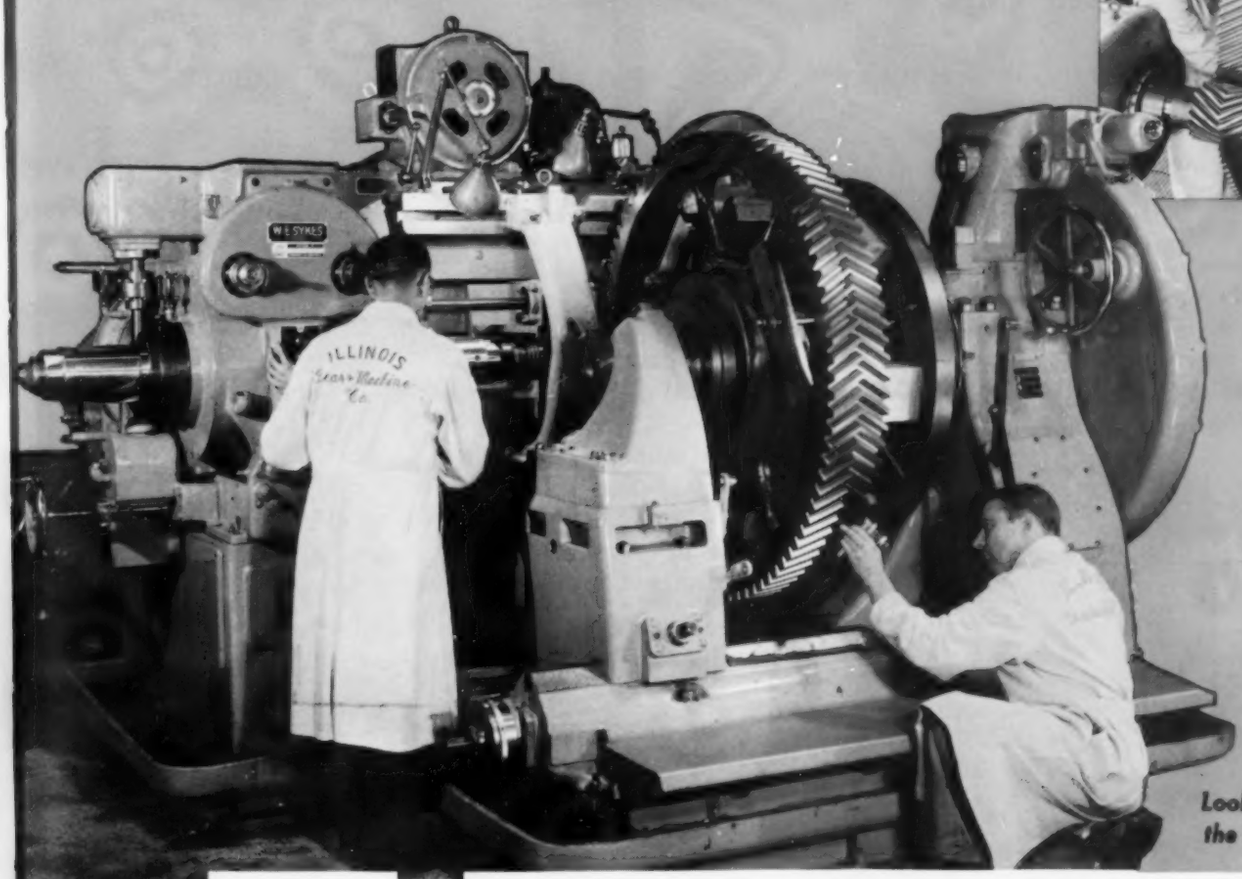
The fine instruments building, also housing the offices, will include the library, conference room, and laboratories for study of the chemical, mineralogical, and physical properties of refractories. The X-ray, spectrographic, microscopic,

Here's how Illinois Gear makes sure of Quality in HERRINGBONE GEARS

If you could look down into the ILLINOIS GEAR plants you would see great batteries of the world's most modern gear producing equipment . . . manned by skilled craftsmen who *know* how to operate this equipment.

Typical of what you would see is the precision Herringbone Gear Generator and Testing Equipment, illustrated here. With unmatched facilities such as these ILLINOIS GEAR can produce one gear, ten thousand or more under the most exacting conditions of quality control . . . and meet delivery dates as promised.

If you are not now using ILLINOIS GEARS find out about the gears that can be made in any quantity with quality as the first consideration, as thousands of customers can testify.



Power testing Herringbone Gears under actual operating conditions.

The Herringbone Gear Generator has a 66" diameter and 18" face capacity. Other generators up to 134" diameter, 54" face capacity.

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HAGAN RING BALANCE FEATURES—NO. 2

SAFE SENSITIVE METERING at 2500, 6000, 15000 PSIG

Rear of Ring Balance Meter with side and top panels removed to show S-tube arrangement. Note the push rod and resistant spring assembly, visible back of S-tube and ring. This feature of the Ring Balance makes possible high sensitivity at low flows and simple adjustment of meter range.

No question about it. The cylindrical tubing used to form the ring and S-tubes of the Hagan Ring Balance meter is the safe, sure means for containing high pressures. There are no gaskets or stuffing boxes to leak, blow out, bind or otherwise spoil this ideal design.

Pressure impulses are brought from the meter terminals to the ring through solid-wall S-tubes which, because of their special configuration and metal-to-metal fittings, provide safe, completely flexible connections and preserve the inherent high sensitivity of the meter.

New, rigid, weatherproof, die-cast, aluminum case. Four-piece back for complete accessibility.

Check these other Ring Balance features with your local Hagan office

1. High sensitivity at low flows due to unique range calibration system.
2. Ease of calibration under operating static pressures with factory-calibrated check weights. No more four-story water columns and telephones.
3. Sealing fluid density and level not critical. No eye-droppers required.
4. Interchangeable ring assemblies for full scale ranges from 0.5″ w.c. to 560″ w.c. Adjustment on any one ring over a 7:1 differential range.
5. Wide range computation and/or compensation by means of built-in, easily checked mechanisms available on most models.
6. Pneumatic or electric transmission also available.

Bulletin MSP-141 describes these features and the new design of the Hagan Ring Balance meter case. ASK US FOR IT.

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OFFICES IN: MONTREAL, TORONTO, VANCOUVER, EDMONTON

and photographic laboratories will be in this building.

The pilot plant building will contain the pilot plant, specialties laboratories, and space for various service functions, including materials storage. The pilot plant building will be equipped with all the facilities needed for the manufacture of refractories in small tonnage lots, including all the various steps of crushing, grinding, sizing, blending, forming, drying and firing. Monolithic refractories, including castables and bonding mortars, will be developed in the specialties laboratories. In the kiln area, special atmosphere kilns will be provided to study the effects of various industrial gases upon commercial refractoriness.

Laboratory manager for the research center will be Donald F. Stock. Raymond E. Birch and Edwin Ruh are director of research and assistant director of research, respectively.

TREADWELL APPOINTS NEW WEST COAST AGENT

▲ R. A. Ashby, San Rafael, Calif., has been appointed a West Coast representative for M. H. Treadwell Co., Inc., Treadwell Engineering Co., and Treadwell Construction Co., in the sale of steel mill equipment and non-ferrous machinery.

GERMAN FIRM ACQUIRES STAINLESS PRODUCER

▲ Continuing its expansion and modernization program, August Thyssen-Huette of Duisburg-Hamborn in the German Ruhr valley, announced that Deutsche Edelstahlwerke of Krefeld, West Germany's largest producer of stainless steel and high grade alloy steel, has been integrated into the Thyssen Group through an exchange of stock.

At the same time Thyssen-Huette also announced that it had purchased 35 per cent minority ownership in the Huettenwerke Siegerland, Europe's largest sheet steel producer. To complete the transaction, Thyssen shares were exchanged for Siegerland shares, in addition to a cash payment. This prime interest in Siegerland, which also produces tinplate, allows Thyssen-Huette an assured, continual market for its hot strip to be processed at the Siegerland mills.

The Deutsche Edelstahlwerke consolidation, recognized by the High Authority of the European Coal and Steel Community, follows the recent Thyssen-Huette union with Niederrheinische Huette, West Germany's largest wire producer, and raises the present combined steel production of the Thyssen Group to 2.8 million tons annually.

The integration between the two companies means that ATH will not reconstruct its dismantled electric steel mill but will rely on the existing capacities of DEW, which will be extended in the future. On the other hand, hot strip, which DEW will require for its new cold rolling mill, to be completed this year in Krefeld, will be provided from the Thyssen-Huette hot strip mill in Hamborn.

ALLIS-CHALMERS FORMS INTERNATIONAL DIVISION

▲ Formation of Allis-Chalmers International as a major operating

WORLD'S LARGEST
OPEN HEARTH FURNACE
Designed and Built By Loftus

Late in 1956, the largest open hearth furnace in the world was tapped at Weirton Steel Company, Division of National Steel Corp., Weirton, W. Va.

Designed and built by Loftus Engineering Corp., this huge furnace has a rated capacity of 600 tons, is approximately 111 feet long by 30 feet wide, and construction was completed in less than a year. Operation is simple since the furnace is equipped with full automatic control.

If you are planning expansion or modernization of your heating facilities (ferrous or non-ferrous), we would like to demonstrate how Loftus' long experience in furnace design and construction can benefit you. Write us today. There is no obligation.

From first heat to heat treat, look to LOFTUS
Engineering Corporation
1 Gateway Center, Pittsburgh, Pa.
140 S. Dearborn St., Chicago, Ill.

57.8.3 A

division of Allis-Chalmers Manufacturing Co. has been announced by R. S. Stevenson, president of the firm.

P. F. Bauer, formerly general manager, Industrial Equipment division, has been named managing director of the new division. Paul Dietz and Floyd J. Mischke were named associate directors of sales of Allis-Chalmers International.

The new division will be responsible for all manufacturing, engineering and sales operations and activities outside of the United States and Canada. Manufacturing operations include plants in Essendine, England, which produces wheel tractors, harvesters and vibrating screens, and in New Castle, Australia, where motor graders are now manufactured.

EXPANDS RESEARCH AND DEVELOPMENT FACILITIES

▲ Expanded research and development facilities are now in operation at The Electric Furnace Co., Salem, Ohio.

An 80 ft x 180 ft long building houses the equipment, laboratories and offices.

The combination gas fired electric strip line, which was placed in operation in 1950 and has been used almost continuously, has been relocated in the new building. This unit was originally constructed with a horizontal 3 pass looping because of floor space limitation. It has an over-all length of approximately 80 ft, including terminal equipment. This line will process strip up to 26 in. in width and coils up to a maximum of 3 tons. The cooling is to be redesigned into a straight line arrangement in the new location, and the over-all length will be 140 ft including the terminal equipment. Whereas the existing equipment will be very largely salvaged as is, several new principles will be built into the cooling section of the furnace, the bridle roll stand and the cooling equipment in the interest of reducing operating cost and accommodating strip of heavier gages.

The furnace heating sections, cooling sections and other units at the upper pass line have been elevated on a substructure to permit storage of coils of strip and certain machine parts beneath the equipment in the interest of conserving floor space.

RITTER APPOINTED AS ALPHA REPRESENTATIVE

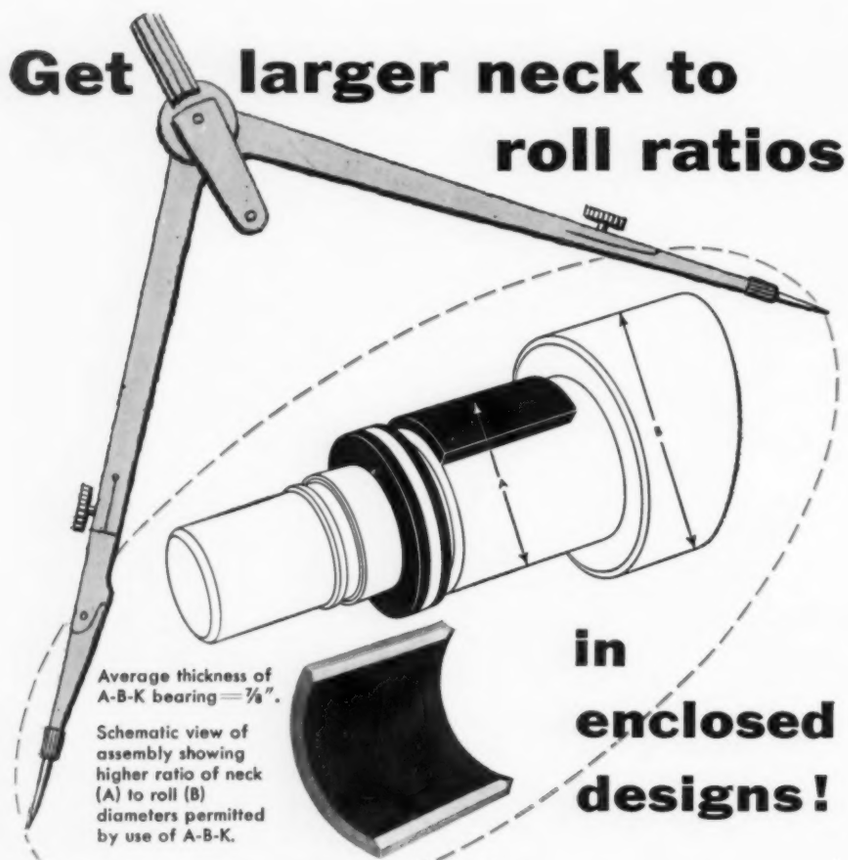
▲Ritter Engineering Co., Inc., Pittsburgh, Pa., has been appointed the exclusive representatives of Alpha Systems, Inc., manufacturers of circulating systems for lubricants and coolants, universal cartridge filter shells and packaged systems, for the metal rolling, paper textile, plastics and heavy machinery fields.

Ritter will cover western Pa., eastern Ohio, and northern W. Va.

NEW BAR MILL HEATING FURNACE NOW OPERATING

▲ The Buffalo District steel plant of Republic Steel Corp. has placed in operation a large new heating furnace for its 14-in. bar mill.

Over two months in shut-down time on the mill were saved by building the furnace off the site


Average thickness of A-B-K bearing = 7/8".
Schematic view of assembly showing higher ratio of neck (A) to roll (B) diameters permitted by use of A-B-K.

Get larger neck to roll ratios in enclosed designs!

use A-B-K* bearings

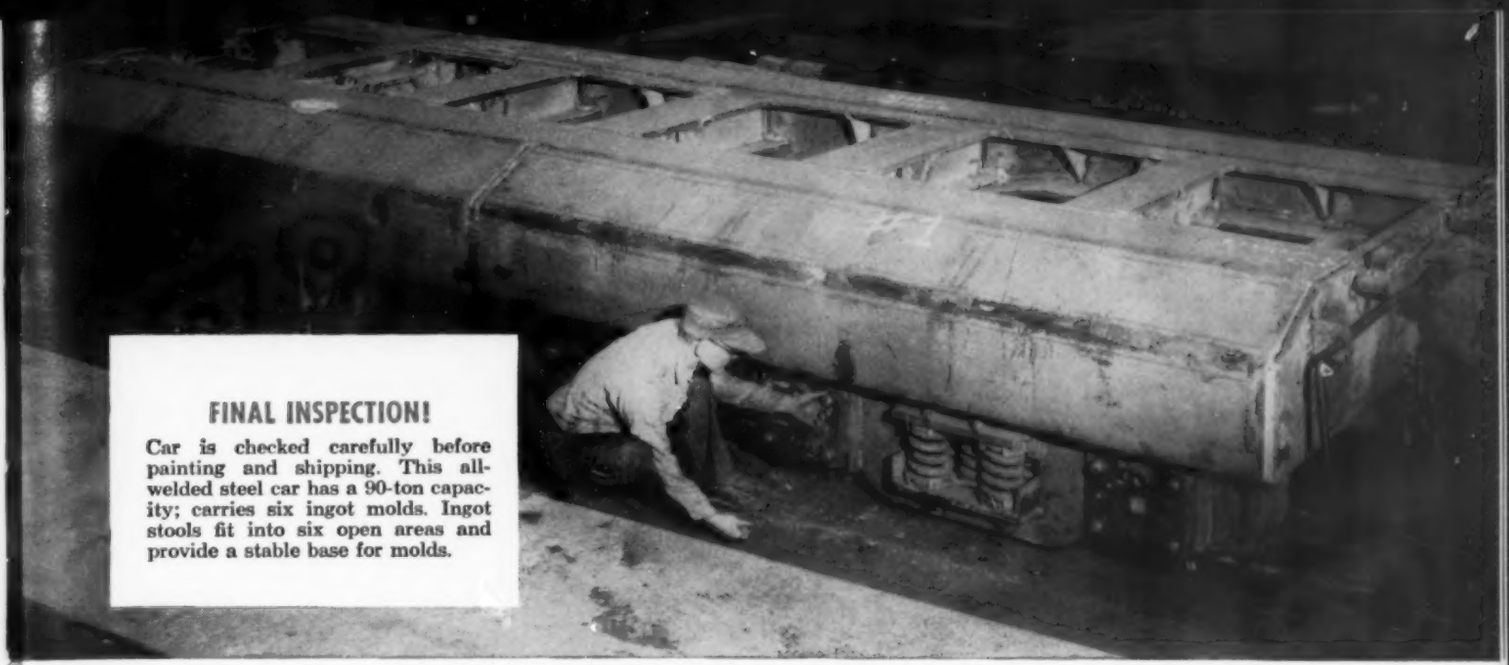
No need to sacrifice roll neck diameters to keep down size and cost of bearing assemblies and housings. A-B-K bearings save space, permit larger, stronger roll necks—with cheaper, lighter weight parts. A-B-K laminated phenolic bearings have ability to absorb and cushion heavier impacts, and often outwear metal, many times. Grease and oil can be used for lubrication but water, alone, is often the answer. Ask our engineers for specific recommendations.

- Wear longer
- Won't score or heat check
- Light in weight
- Cut lubricant costs
- Save power

A-B-K
LAMINATED
PHENOLIC BEARINGS

*A registered trade-mark of American Brake Shoe Company in the United States and of Joseph Robb & Company, Limited, in Canada.

American Brake Shoe Company
American Brakeblok Division
DETROIT 9, MICHIGAN



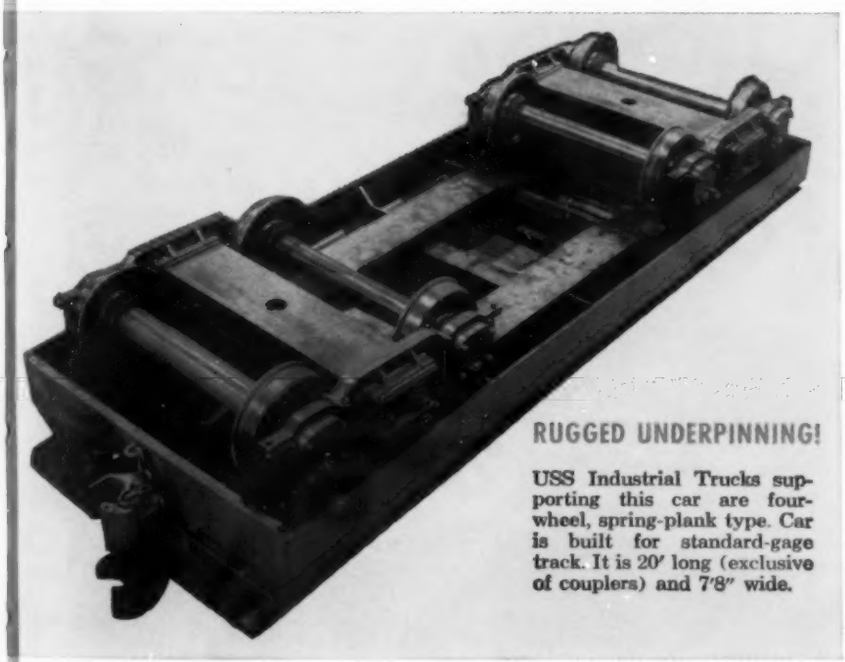
FINAL INSPECTION!

Car is checked carefully before painting and shipping. This all-welded steel car has a 90-ton capacity; carries six ingot molds. Ingot stools fit into six open areas and provide a stable base for molds.

INGOT MOLD CARS

USS-DESIGNED

to your specifications



RUGGED UNDERPINNING!

USS Industrial Trucks supporting this car are four-wheel, spring-plank type. Car is built for standard-gage track. It is 20′ long (exclusive of couplers) and 7′8″ wide.

NAME THE KIND OF CAR YOU NEED in your steel plant, and chances are that United States Steel can supply it. Our engineers specialize in designing and building industrial cars to meet users' requirements exactly.

The ingot mold car pictured here is a good example of our custom-made cars. This all-welded steel car has a capacity of 90 tons. The deck plate is provided with six open areas to accommodate the ingot mold stools.

USS-Designed Ingot Mold Cars can be built in a wide variety of types and sizes—from cars weighing 8,000 pounds, designed to carry two small ingots . . . to cars weighing more than 66,000 pounds, capable of carrying loads up to 250 tons.

Cars can be built for either narrow or standard-gage track. Trucks have four or eight wheels. Anti-friction bearings are either inboard or outboard. Cars can even be equipped with flexible trucks that permit movement over irregular track.

For more information, send for a free copy of our 32-page illustrated booklet—"USS Custom Designed Cars." And remember, you can call in our engineers for consultation at any time.

USS INDUSTRIAL CARS

UNITED STATES STEEL CORPORATION, PITTSBURGH
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

UNITED STATES STEEL

United States Steel Corporation
525 William Penn Place, Room 2801
Pittsburgh 30, Pennsylvania

Please send me a free copy of your 32-page booklet, "USS Custom Designed Cars."

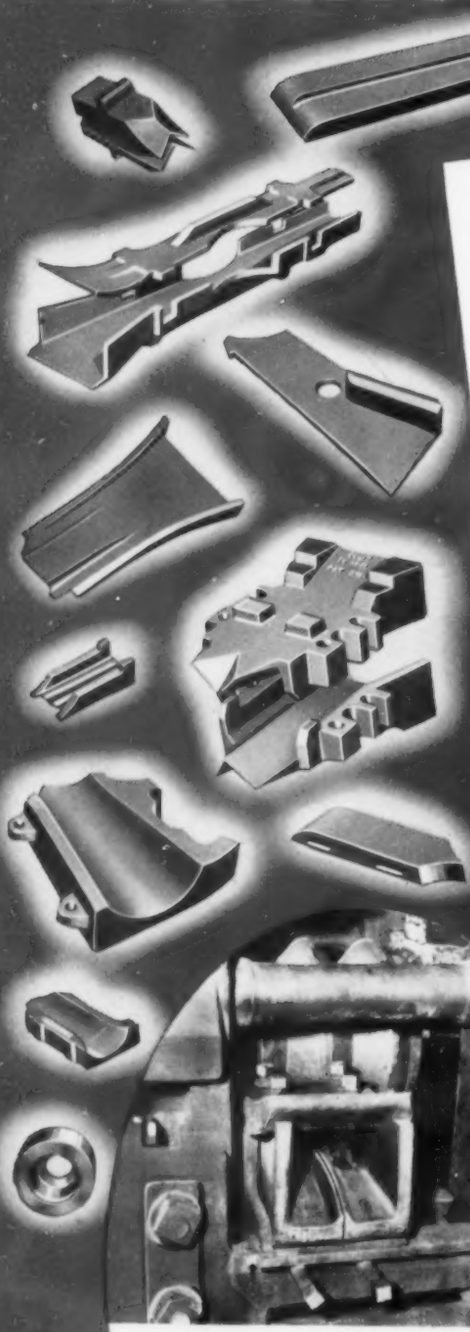
Name .....

Company .....

Address .....

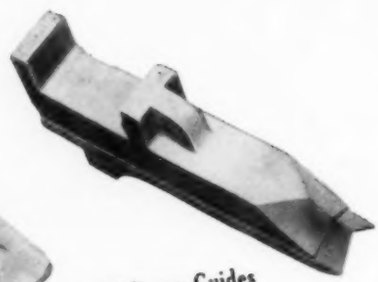
City ..... State .....

TRANTINYL GUIDES
THE STEEL INDUSTRY



Steel Producers amazed at HIGH TONNAGE rolled with TRANTINYL GUIDES

Entry Guides



Delivery Guides

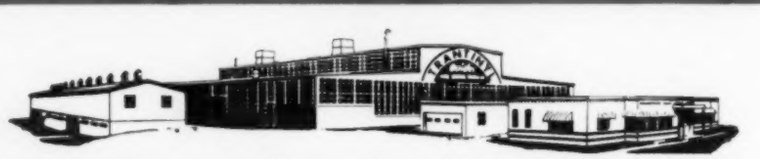
Two pair of angle guides, still in serviceable condition after long usage

These entry and delivery guides on 12" mill were photographed in a midwest steel plant after rolling unusually high tonnage. Guides showed no noticeable signs of wear and proved again the outstanding durability of "TRANTINYL." If you have not yet tested "Trantinyl" guides to your own satisfaction, why not try them now.

12" Mill showing Entry Guides

"Trantinyl" Guides and Rollers hold exceptionally high tonnage performance records, in serving leading steel mills for a quarter-century. Rolling more than 100,000 tons over a single pair of guides has been recorded.

Guides for Rolling Mills • Tube Mills
Straightening Machine Guides
Heat-Resisting "Trantinyl" Cast-to-Shape



Youngstown Alloy Casting Corporation

Youngstown, Ohio

Sole Licensee to cast "TRANTINYL" for the Midwest, West and South: WAUNAKEE ALLOY CASTING CORP., Waunakee, Wis.

where it would be used and then moving it into position. Weighing over 2000 tons, the furnace is one of the largest fabricated objects ever moved in the Buffalo area.

The furnace, which has more than twice the heating capacity of the furnace it replaces, will sharply increase the capacity of the 14-in. mill. This mill rolls more than half the tonnage shipped from the plant.

This work was part of a major rehabilitation of the mill which was completely torn apart, inspected and rebuilt. New rolls, drives, pinions and other parts were installed as required.

The furnace was constructed on hundreds of 2¾-in. diam, steel rollers which in turn were placed on four 12-in. (H) beam skids, imbedded into the foundation and leading to the ultimate furnace location.

Even while the old furnace continued to operate, excavation work for new foundations went on all around it. Even the building housing the mill had to be expanded to accommodate the greater length of the new furnace.

When the new furnace was nearly finished, the mill was shut down and the old furnace torn out. When the foundations were ready, two powerful hydraulic jacks were placed behind the huge furnace and began to push it gently forward. About 23 hours later, the furnace was in position.

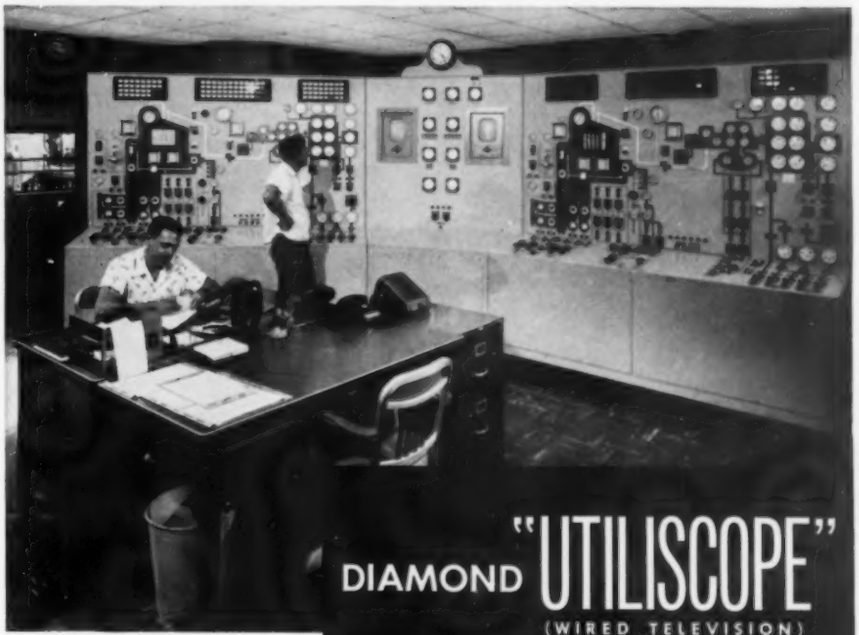
The off-site construction permitted completion of the job in about three weeks, compared with the three months which would have been required by routine construction.

While this work was going on, other crews were completing the major reconditioning of the 14-in. mill itself.

A new shuffle bed, where steel billets are unscrambled and placed in position for charging, was built. A new charging table with two new motors was constructed and a new billet turner and new pushers installed.

A new scraper for dry removal of scale has been installed under the table. The scale will be collected directly in a bucket which will sharply reduce the chance of any stream pollution by mill scale from this mill.

AUTOMATION IN POWER PLANTS



DIAMOND "UTILISCOPE"
(WIRED TELEVISION)
HEAVY DUTY EQUIPMENT FOR VISUAL INFORMATION

"UTILISCOPE" CAMERA

"UTILISCOPE" RECEIVER

The Diamond "Utiliscope" makes possible the ultimate in automation for power plant control. It enables the operator to see clearly anything that requires visual check. He no longer need depend upon indirect interpretations to know what is happening outside his range of vision.

The operator in the above photograph is watching the ITV image of the water level in two boilers . . . transmitted by "Utiliscope" cameras focused on Diamond Bi-Color water gauges. The water levels are easily and unmistakably read on the viewing screens. There can be no error . . . the level is shown correctly or there is no picture.

The Diamond "Utiliscope" is heavy duty equipment for power plant application. Other power plant uses are: watching flame conditions in boiler furnances, watching smoke emission from stacks, and watching remote entrances for intruders. Have you explored the "Utiliscope's" resources for saving money and improving operation? Use the coupon below for further information.

Diamond

DIAMOND POWER SPECIALTY CORP.
FIRST IN INDUSTRIAL TELEVISION
LANCASTER, OHIO
OFFICES IN 39 PRINCIPAL CITIES
Diamond Specialty Limited—Windsor, Ontario
Since 1903, Diamond has Manufactured Quality Equipment for Industry

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DIAMOND POWER SPECIALTY CORP.
ELECTRONICS DEPT., P.O. BOX 57PP
LANCASTER, OHIO

Please send me without obligation a copy of bulletin showing how Diamond Industrial (Wired) Television will help me reduce costs and improve operations.

Name_____

Title_____

Company_____

Address_____

The Perils of Penny-Wise Pete

A mere 2½ Horsepower and 1 Manpower aren't enough to push Penny-Wise Pete's expensive new 15-foot runabout. He's in trouble!

Bonding high price, top quality firebrick with so-called "economy" refractory mortar means trouble, too.

Real economy is to use Super #3000 — the *refractory mortar which outlasts the brick it bonds*. Difference in cost, on most installations, is actually negligible. Super #3000 guarantees minimum down-time, greater production — and that's where the *real* profit lies.

Super #3000 is the *only* refractory mortar which equals or even surpasses the strength, resistance to heat, erosion and abrasion of the best grades of refractory brick. Countless service reports prove it.

Write on your letterhead for a free trial drum of Super #3000, without obligation.

REFRACTORY & INSULATION CORP.

R&I

REFRACTORY BONDING AND CASTABLE CEMENTS
INSULATING BLOCK, BLANKETS AND CEMENTS

136 WALL STREET • NEW YORK 5, N. Y.

On the mill, pinch rolls and hot shears were completely reconditioned. New electrical controls were installed and relocated to consolidate two operations in one place. The hot bed onto which the steel is moved after rolling was completely overhauled.

Closed circuit television, the first in use by Republic, has been installed on the new heating furnace.

The camera will enable a man at the discharge end of the furnace to charge the furnace at the entry end.

With the new TV circuit, the push-out operator will be able to see steel billets moved into position at the opposite end of the furnace by another operator. When they are properly positioned, he will operate the charging mechanism which will slide them into the furnace. The camera is located above the charging table; the receiver, at opposite end of the furnace by the push-out operator.

Meetings

▲ The Second International Conference on Nondestructive Testing is to be held in Chicago, Ill., November 3–8.

This Conference is being held in conjunction with the Second World Metallurgical Congress sponsored by the American Society for Metals.

▲ The Galvanizers Committee of the steel industry, sponsored by the American Zinc Institute, will hold its thirty-seventh meeting on October 31–November 1, at the Pick-Ohio Hotel, Youngstown, Ohio. This Committee consists of technical and operating representatives of the major steel producers in the United States and Canada who are also engaged in galvanizing sheet or pipe.

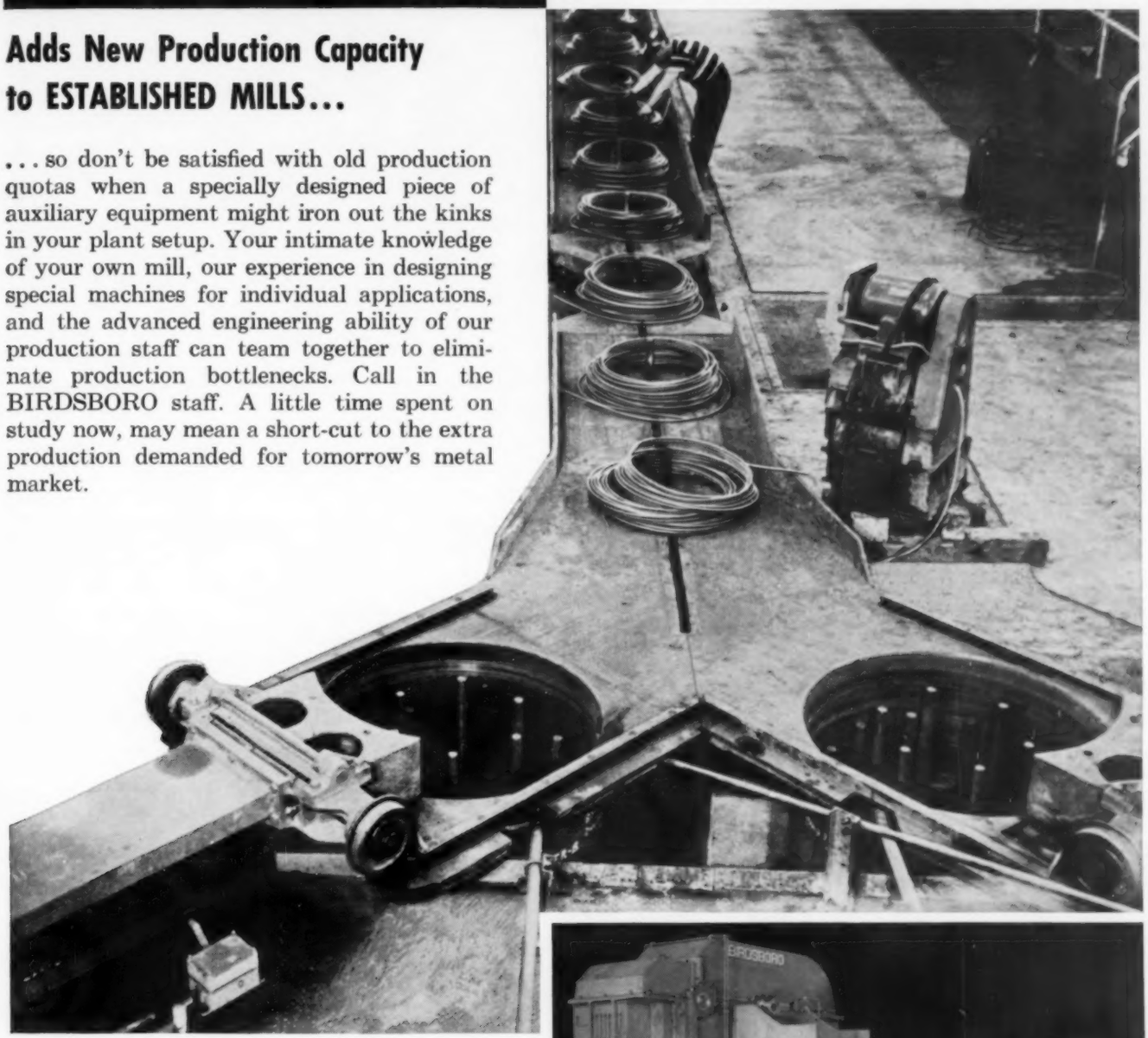
▲ The 15th Annual Electric Furnace Conference will be held in the Penn-Sheraton Hotel, Pittsburgh, Pa., December 4–6.

▲ The National Metal Trades Association's 58th annual convention will be held in Chicago, Ill., October 31 through November 2. The three-day convention will feature a series of speeches, panel discussions and association business meetings.

BIRDSBORO Auxiliary Mill Equipment

Adds New Production Capacity to ESTABLISHED MILLS...

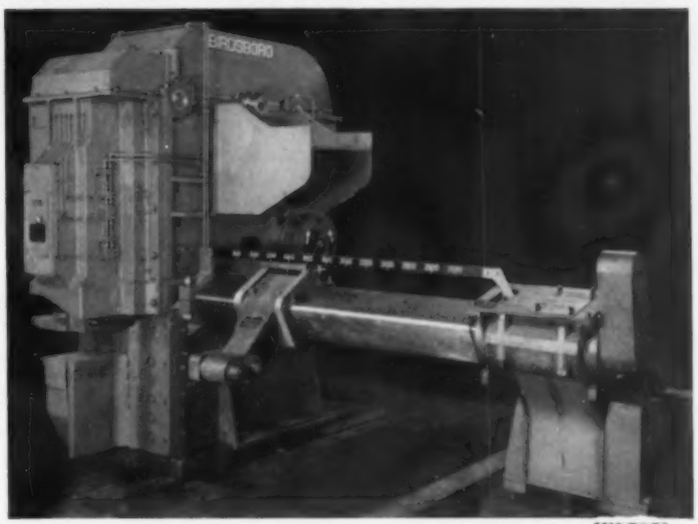
...so don't be satisfied with old production quotas when a specially designed piece of auxiliary equipment might iron out the kinks in your plant setup. Your intimate knowledge of your own mill, our experience in designing special machines for individual applications, and the advanced engineering ability of our production staff can team together to eliminate production bottlenecks. Call in the BIRDSBORO staff. A little time spent on study now, may mean a short-cut to the extra production demanded for tomorrow's metal market.



DESIGNERS AND BUILDERS OF:

- STEEL MILL MACHINERY
- HYDRAULIC PRESSES *(Metalworking and Extrusion)*
- CRUSHING MACHINERY
- SPECIAL MACHINERY
- STEEL CASTINGS
- Weldments "CAST-WELD" Design
- ROLLS: Steel, Alloy Iron, Alloy Steel

20"-18"-14"-12"-10" Combination Mill Rod Coilers and Rod Coil Conveyor.



This 350-ton Birdsboro Up and Down Cut Shear and Gauge is used for hot shearing of 8" x 8" carbon steel blooms.

MM-54-56

BIRDSBORO

BIRDSBORO STEEL FOUNDRY & MACHINE CO., Main Offices in Birdsboro, Pa. District Office: Pittsburgh, Pa.

New York Office: **Engineering Supervision Co.,** *120 West 42nd Street, New York 36, N.Y.*

IT'S TAPER-LOCK! IT'S ALL STEEL!

FULL-DEPTH WELD GIVES 100% STRENGTH

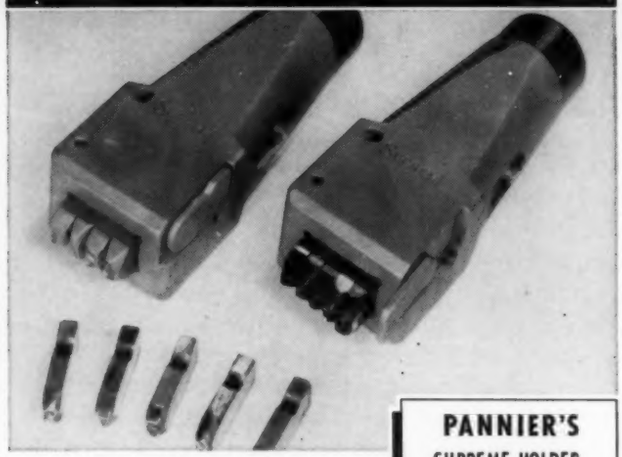
Modern! Superior! Taper-Lock Steel Conveyor Pulleys have terrific impact capability. All welds are made by the submerged arc process for 100% strength. Taper-Lock's back-up bar (pat. applied for) permits a weld of full rim thickness. Diameters 6 inches to 8 feet, all face widths. Popular sizes stocked by Dodge Distributors. Write us for data.

DODGE MANUFACTURING CORPORATION, 5900 Union St., Mishawaka, Ind.

DODGE

of Mishawaka, Ind.

ANOTHER *PANNIER* MASTER MARKER!



New Roto-Pin type lock is integral part of *all* Pannier Supreme Holders ... eliminates loose, bent, dropped, or lost pins ... flip it open to change type ... flip it back to securely lock type in clear-marking position.

PANNIER'S SUPREME HOLDER WITH ROTO-PIN LOCK

Safe, fast type changing. Holder in variety of styles. Machined from High-Grade Bar Tool Steel. Hardened anvil maintains type alignment. Striking Head of Tool Steel ... Replaceable to add long service life to Holder.

BIRTHMARKED MATERIALS

Write for complete data.

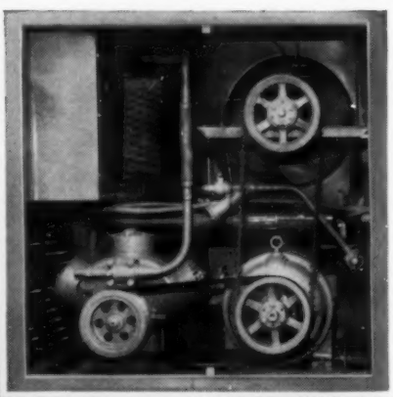
MARKING DEVICES

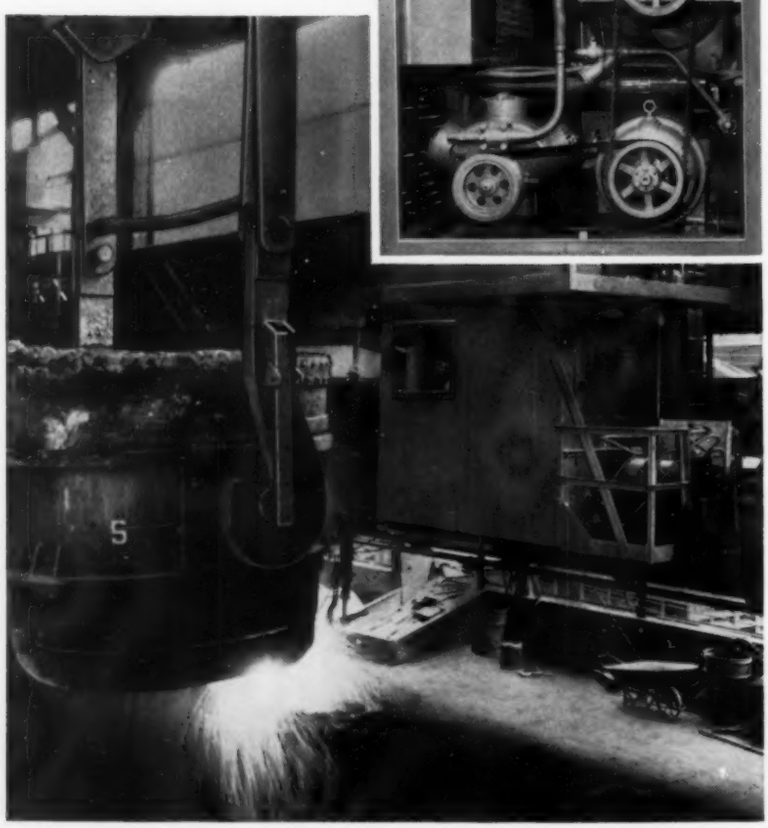
THE PANNIER CORPORATION

302 Pannier Building • FAirfax 1-5185 • Pittsburgh 12, Pa.

Offices: Los Angeles • Chicago • Cleveland • Philadelphia

Condenser section of a 7½ hp unit. Note easy access to all components.





Productivity gets a lift from crane cabs that stay cool

Operator efficiency goes down when cab temperatures go up. That is why crane engineers demand crane cab conditioners that are dependable.

Dravo Crane Cab Conditioners *are* dependable because:

BASIC DESIGN—rugged construction and heavy duty components fit Dravo Conditioners for continuous service under the most severe operating conditions.

HIGH EFFICIENCY—low operating temperatures in condenser section, together with reduction of compressor head pressure step up unit efficiency.

EASY MAINTENANCE—all components readily accessible. Inspection need not interfere with conditioner operation.

For information on Dravo Crane Cab Conditioners, write for Bulletin #1350-33, Dravo Corporation, Pittsburgh 22, Pennsylvania.

DRAVO

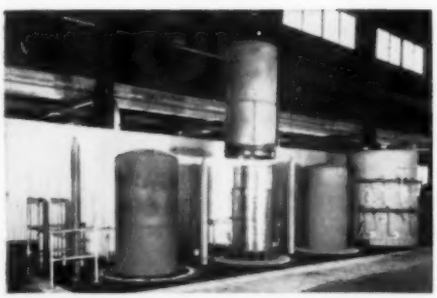
CORPORATION

DRAVO

Part of an installation of large gas fired three-stack rectangular bell type forced circulation special atmosphere furnaces for annealing strip.

Bell Type FURNACES

Built to Suit Your Plant, Product or Process



Built right—over 20 years ago—this EF installation is still in operation, daily—and producing first class work.

Single or multi-stack — circular, rectangular or square types — upright, elevator or partial pits — gas fired, oil fired or electric — correctly designed, built and installed, ready to produce.

Backed by over 40 years of practical furnace building experience, EF furnaces incorporate all the advantages of all bell type designs, for processing strip, wire, rod and other ferrous and non-ferrous products.

EF bell type furnaces installed over 20 years ago are still in service daily, producing first class work. After all, there's no substitute for experience. At your convenience EF experienced engineers will be pleased to discuss the best type for your specific requirements.

EF direct gas fired forced circulation bell type furnace for processing wire, rod, strip and other products. The split cover design permits installing where head room is limited.

THE ELECTRIC FURNACE CO.

GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT OR PRODUCTION

Salem - Ohio

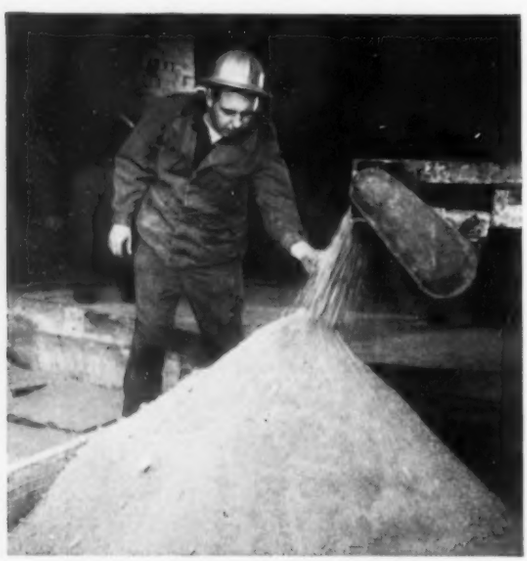
Canadian Associates • Canefco Limited • Toronto 1, Canada

EF direct gas fired special atmosphere forced circulation, single stack circular bell steel strip annealers, each accommodates three 48" x 40" 15,000 lb. coils (45,000 lbs.)

Part of another installation of large EF gas fired three-stack rectangular bell type forced circulation special atmosphere furnaces for annealing steel strip.

EF gas fired special atmosphere rectangular bell type strip annealers with individually controlled forced circulation three-stack bases each with capacity of 135,000 lbs. per charge.

UNITED STATES STEEL CORPORATION—with a successful six-year experience using Permanente 165—adds another Permanente 165 bottom at #5 Open Hearth Shop, Homestead Works.



EACH BATCH of Permanente 165 Ramming Mix is checked for correct moisture content by a Kaiser Chemicals' Technician.

U. S. STEEL INSTALLS

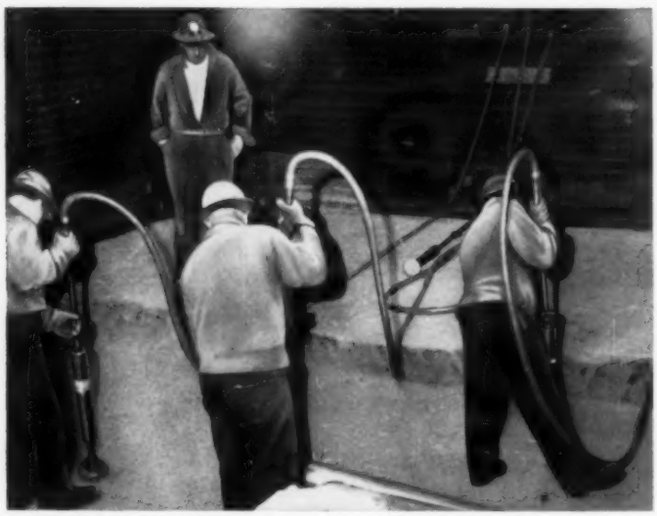
This Permanente 165 bottom is the 91st for United States Steel Corporation . . . and at #5 Open Hearth Shop, Homestead Works, it becomes the *tenth* furnace with a 165 bottom out of eleven furnaces on the line.

There is a good reason why U. S. Steel is using more and more 165 for furnace bottoms.

Experience has *proved* that it lasts significantly longer than other materials . . . that it requires fewer repairs and less down time . . . that it helps produce greater tonnage at lower bottom cost!

One of the reasons for this performance is Permanente 165's complete resistance to hydration under the most severe conditions. Another is its remarkable resistance to attack by iron oxide and slag. And still another is its installed high density—averages 175 lbs. per cubic foot *in the bottom where density means longer life.* Permanente

RAMMERS COMPACT 165 against back wall as furnace bottom nears completion. When on line again, furnace will produce 300 tons of steel per heat.



CAREFUL RAMMING assures dense monolithic bottom after burn-in with more pounds of MgO per cubic foot (165 lbs.) than any other ramming mix.

IN PRODUCTION this new tap hole lasted 108 heats before repiping. Sub hearth shown here plus other portions of furnace were built of Kaiser Periclase Brick.

ITS 91st PERMANENTE 165 BOTTOM

165 is made from high purity Kaiser Periclase refractory grains, 94-96% MgO. And because it ceramically bonds itself into a crystalline mass at relatively low temperatures, you get a tough, dense homogeneous bottom fast.

A new, completely revised 28-page manual, "Suggested Methods of Installing Permanente 165 and 84 Ramming Mixes," gives complete details. Send for your free copy.

Call or write Kaiser Chemicals Division, Dept. R7452, KAISER ALUMINUM & CHEMICAL SALES, INC., at any of the regional offices listed below.

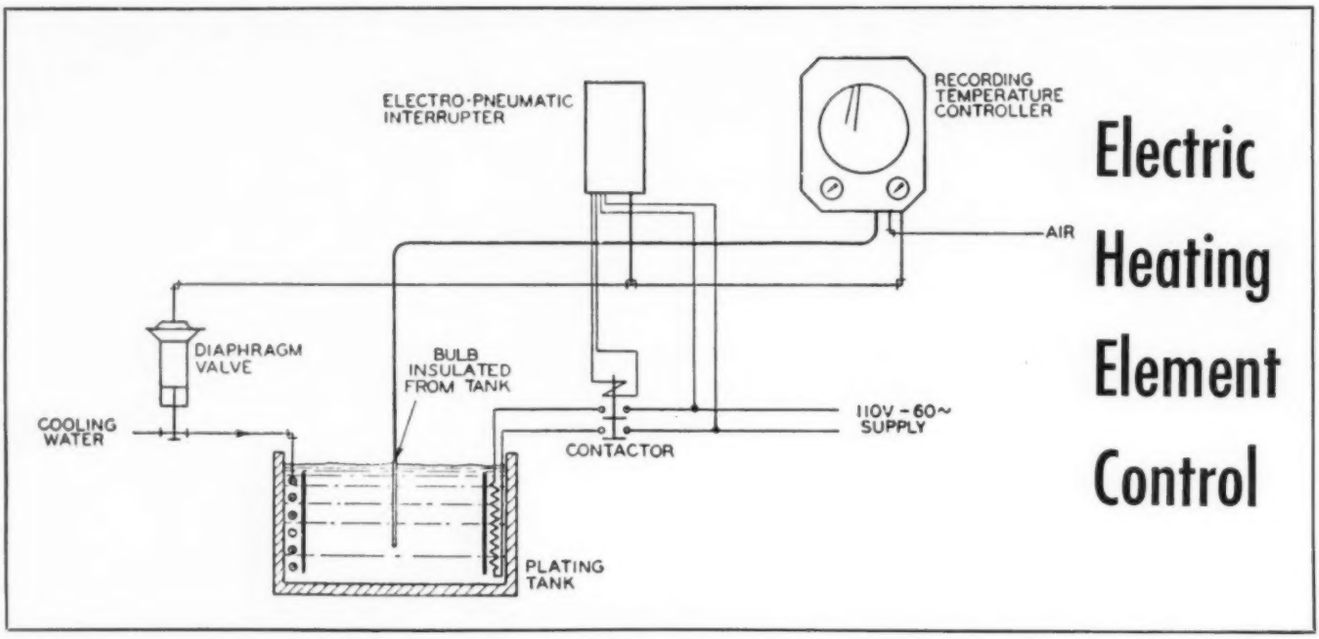
PITTSBURGH 22, PA. . . . 3 Gateway Center
HAMMOND, IND. . . . 518 Calumet Building
OAKLAND 12, CALIF. . . . . 1924 Broadway

Kaiser Chemicals

Pioneers in Modern Basic Refractories

REFRACTORY BRICK & RAMMING MATERIALS • CASTABLES & MORTARS • MAGNESITE • PERICLASE • DEADBURNED DOLOMITE • ALUMINAS

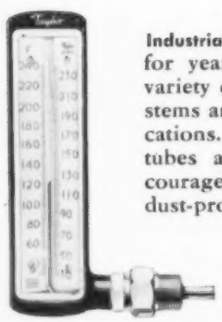
These *Taylor* instruments



Plating Bath Temperature Control System, using electrical heating elements. FULSCOPE* Temperature Controller operates a Taylor Electro-Pneumatic Interrupter and reverse acting diaphragm valve. Both heating and cooling facilities are shut off by controller provided correct operating temperature is maintained.

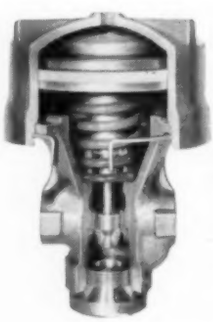
Bi-Therm* Bi-Metallic Dial Thermometer Gives high accuracy at low cost. All-stainless steel construction. 3″ or 5″ diameter case. Stems 4″, 6″, 9″, 12″. Separable wells, ¾″ and 1″; 2″ extension neck for 6″ and 12″ stems. Ranges from minus 40° to plus 750°F.—up to 400° damped against vibration.

Pitot-Venturi Flow Element For measuring velocity of liquid or gaseous mediums. Develops a differential approximately 10 times that of a Pitot tube alone, for air velocities in excess of 1000 ft. per minute. Calibrating ring determines exact relationship between flow and differential. Compact—ideal where space at a premium. Brass or type 316 stainless steel.



Industrial Thermometers Ruggedly built for years of accurate service. Wide variety of mounting angles; choice of stems and connections to fit all applications. Exclusive Taylor BINOC* tubes are 3-times-easier-to-read—encourage frequent checks. Rattle-proof, dust-proof cases, thick protective glass.

*Reg. U.S. Pat. Off.



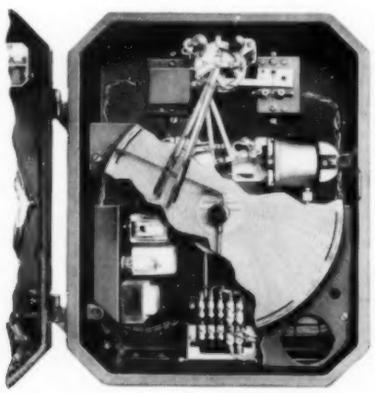
Taylor-Emmett Valves New Teflon disc design in Type D532 Cylinder Operated Valve shown here means that valve requires practically no maintenance . . . never needs grinding. Taylor-Emmett valves represent a major step forward in compactness, simplicity of design and long life expectancy. Only ¼ the parts of conventional valves. Attractively priced.

can save you money . . .

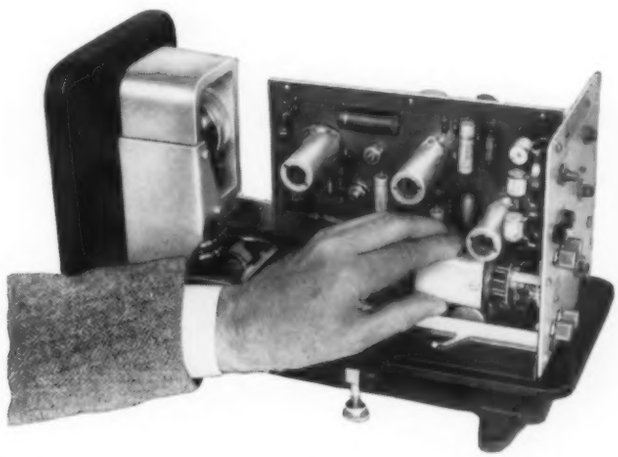
SEE THEM ALL AT THE METAL SHOW

Taylor instruments and control systems like those shown here can help reduce your operating costs, keep your quality high. Throughout industry Taylor has a reputation for producing rugged, accurate and dependable instruments—and for providing field service "above and beyond the call of duty".

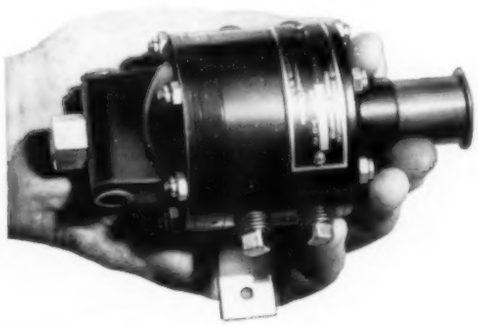
As today's advanced metals production and processing methods call for more and more automatic control it will pay you to call in your Taylor Field Engineer. His advice is yours for the asking. If you prefer, write for **Bulletin 98261.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.



Electronic Contact Controller Gives rugged, positive contact action for 2-position action type controls. Designed for on-off applications with small process lags, slow reaction rates, small and infrequent load changes. For use on temperature, pressure, flow, liquid level, humidity, etc. measuring systems. Indicating, recording and/or controlling.



Taylor Potentiometer Transmitter Completely adaptable for measuring wide variety of variables—ideal where processing conditions require pneumatic controllers and receivers and conventional circuits not adequate. Plug-in service "can" facilitates operation from resistance thermometers, strain gages, thermocouples, tachometers. Unit continuously standardized automatically. No slide wires, no batteries, no moving parts.



Low Cost Flow Transmitter No. 200TD111 Fixed Range Differential Pressure Transmitter measures flow, liquid level or pressure extremely economically. Dimensions 6½" x 3", weighs only 4½ lbs. Calibration accuracy better than 1%. Sensitivity exceeds 0.1%. Ranges 0 to 50, 100, 200 and 300 inches of water . . . easily and quickly changeable.

National Metal Exposition

Booth No. 1885

Taylor Instruments

MEAN

ACCURACY FIRST

VISION · INGENUITY · DEPENDABILITY

Designed by Experience

HEAVY-DUTY CAM-OPERATED

600 Volts A-C or D-C

● The Euclid Electric & Mfg. Co. (Madison, Ohio) has added a complete new line of Pendant Push-Button Stations to incorporate all of the many features that years of experience have proved desirable. Designed for heavy-duty applications, these cam-operated Stations are rated 600 volts, a-c or d-c. They are available from one to five speed-points in each direction for a total of eight circuits to provide for practically an unlimited number of different sequences of operation.

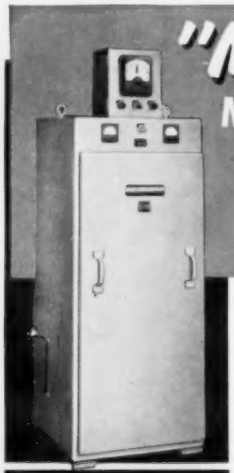
Sturdily constructed to withstand hard usage and abuse, their small cross-section permits comfortable, non-fatiguing, one-hand operation. Steel shrouds guard the large operating buttons. The heavy, all-welded steel frame (that includes the end-caps and front) has a heavy, fiber-glass, easily-removed rear cover that affords quick inspection of the silver-to-silver contacts without disturbing any wiring. The threaded conduit fitting is an integral part of the top end-cap which also has welded to it a double-suspension cable hanger.

Extra features include heavy-duty, control-circuit toggle disconnects, pilot lights, selector switches, and maintained-type contacts.

ASK FOR BULLETIN 2015

THE EUCLID ELECTRIC & MFG. CO.
MADISON, OHIO

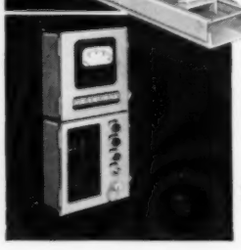
THE EUCLID ELECTRIC AND MFG. CO., MADISON, O. — EUCLID



"MEASURAY"

MEASURES THICKNESS ACCURATELY *without* TOUCHING *the* MATERIAL

Hot or Cold Strip Steel, Brass, Copper, Aluminum . . . Plastics, Foils, Coated Fabrics, Film, Rubber, Etc., Even When Moving At High Speed.



Simple method—the "Measuray" shoots X-Rays through the material—measures its absorption of the rays. Calibrated meter registers plus or minus per cent of deviation from pre-determined standard. Especially useful on hot mills where material can't be checked by contact gages. Also when material can be deformed by contact such as foil.

"Measuray" is accurate to 1% of thickness or less. Quickly pays for itself in reduced scrap.

*Write Today for Literature to Dept. 25, **The Sheffield Corporation**, Dayton 1, Ohio*

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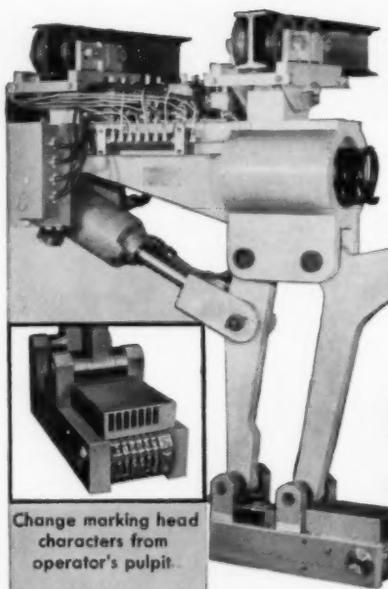

How to mark BLOOMS, SLABS and BILLETS by REMOTE CONTROL

Change marking head characters from operator's pulpit

Mecco SAFETY BILLET MARKER

New marking head allows cut letters and ingot numbers to be changed instantly from the operator's pulpit. Wide versatility for stamping ends of blooms, slabs, and billets. *Write for Bulletin 613-D on new Billet Marker.*

A product of the Marking Device Industry

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VICTOR R. BROWNING

Mill Type Cranes

TO SPECIFICATION...

Basically designed as required by A.I.S.E. specifications, mill type cranes built by Victor R. Browning & Co., Inc. also offer the opportunity of specifying preferences and standards prevailing in the purchaser's plant. May we have your next inquiry?

VICTOR R. BROWNING & COMPANY, Inc.

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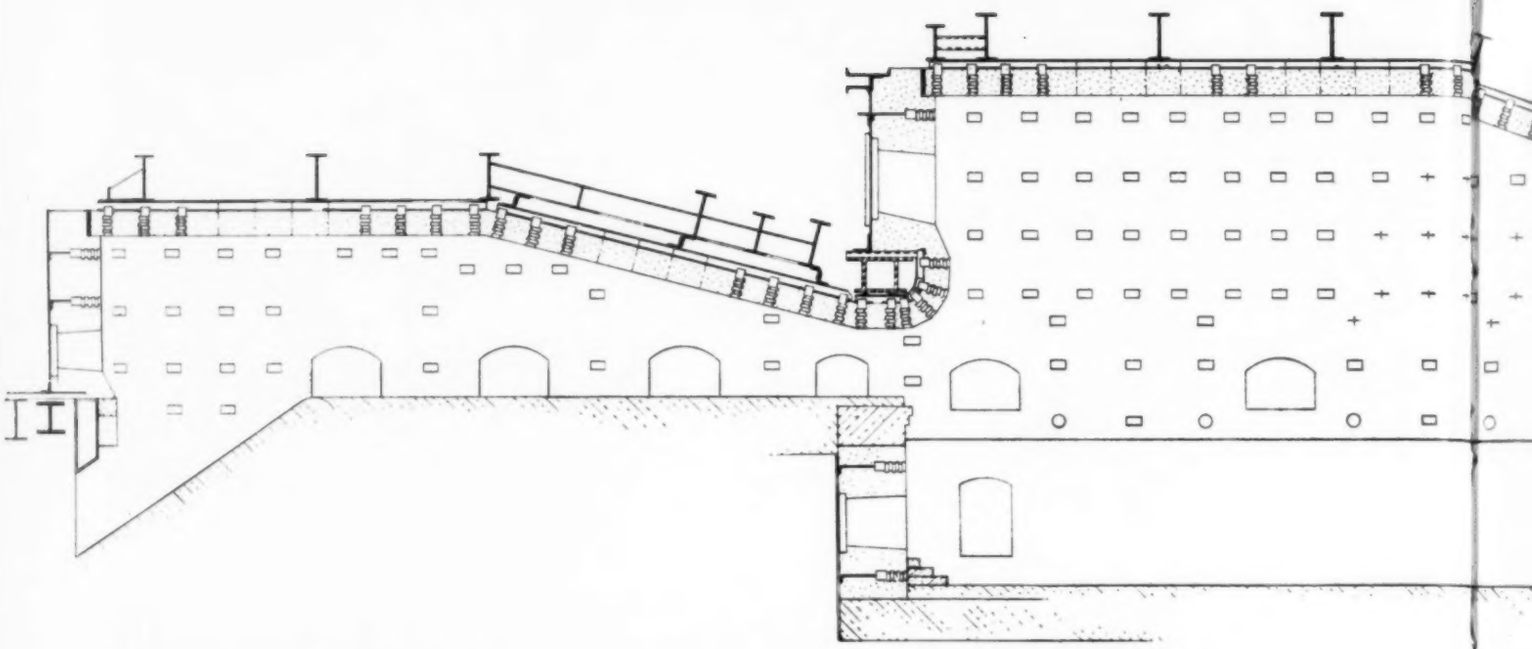
DESIGNERS AND BUILDERS OF ELECTRIC OVERHEAD TRAVELING CRANES AND HOISTS AND ELECTRIC REVOLVING CRANES

REPEAT PERFORMANCE



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with complete RT

at U. S. Steel Corporation

Irvin Works,

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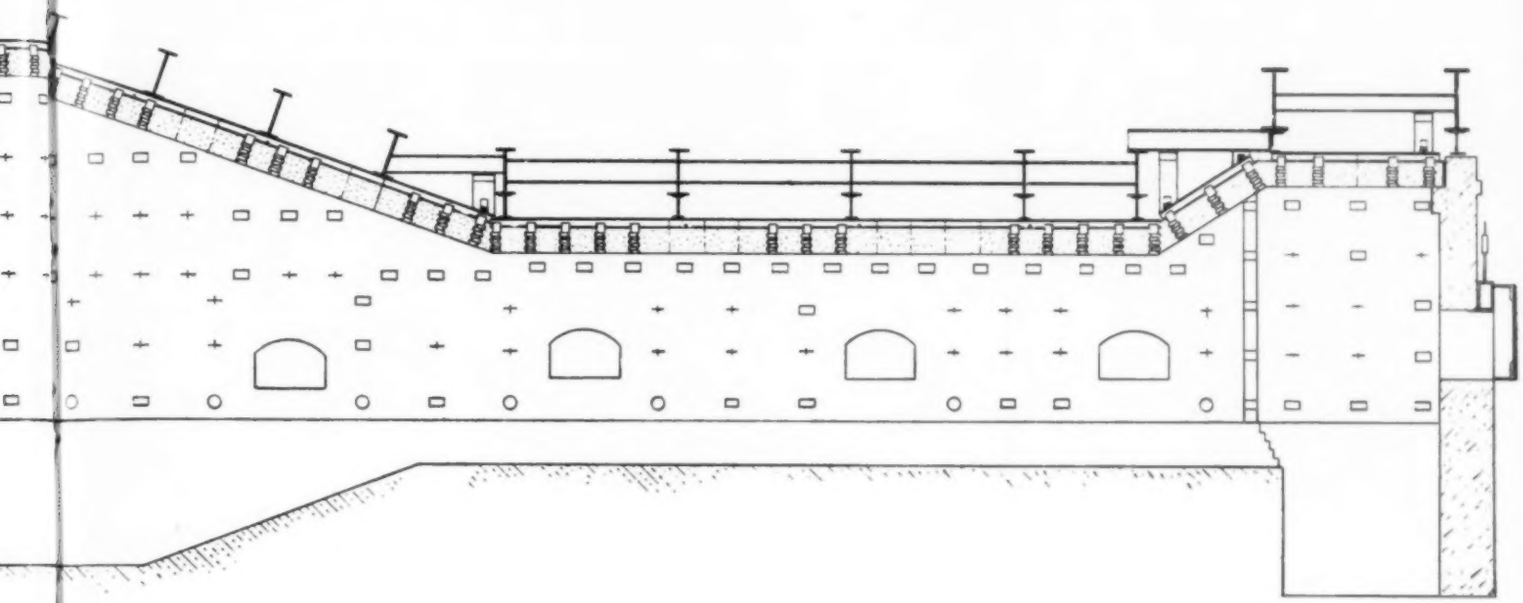
BY REQUEST!



edb heating furnace (No. 5)
RTITE® enclosure

The decision to use RAMTITE in the new No. 5 furnace was based on previous experience—up to four and one-half years in all side walls, burner walls, soak and heat zone roofs in the four existing furnaces.

The new No. 5 furnace (87′6″ long by 23′2″ wide overall) was designed and built by RUST FURNACE COMPANY. Another new furnace order for RAMTITE for the following reasons.

1. High thermal efficiency reduces heat loss, permits a reduction in wall thickness over standard fired shape construction. Wider furnace permits heating longer slabs.
2. Monolithic construction reduces air and fuel gas leakage over fire brick enclosures.
3. Inherent spall resistance assures low maintenance and longer refractory life.

Whatever your furnace requirements, for performance and repeat performance, depend on Ramtite products and Ramtite service. Experienced men are always available to study your refractory problems and consult with your Engineering, Mason and Ceramic Departments about your specific needs.

For further information, call your local RAMTITE representative.

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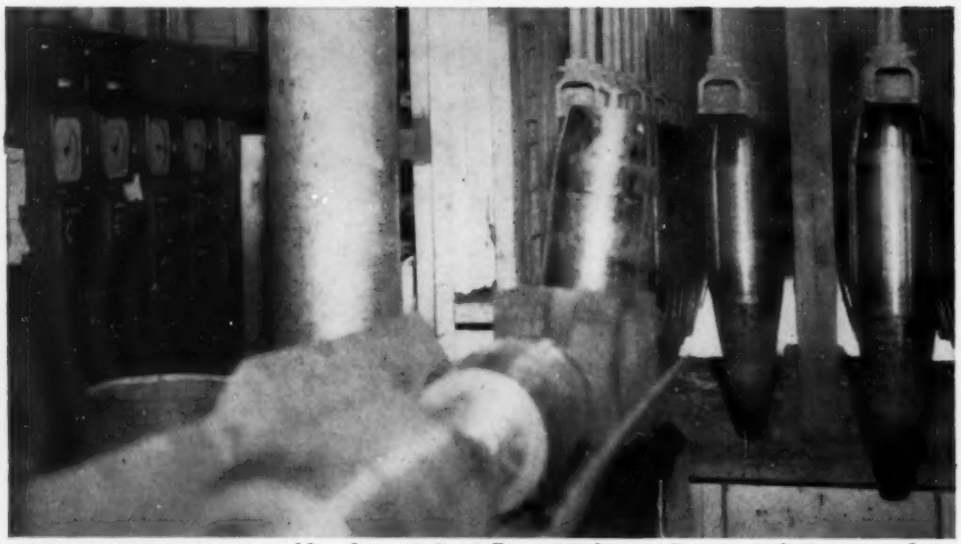
BRISTOL'S

Instrumentation News

• *News of instrumentation and automatic control in industrial heating and metallurgy* •



HEAT TREATING FURNACE—cold end—at U.S. Hoffman Machinery Corporation's Scranton plant. Heat treatment of projectiles, seen entering furnace at right, is automatically controlled by instruments at left.

INSTRUMENTS LIKE THESE control temperatures in rotary Hagan furnaces at U.S. Hoffman Machinery Corporation's plant. One of six installations.

World's largest hot-forge shell plant gets Bristol control

Continuous heat control is a must in the manufacture of high-explosive shells for the U.S. Army Ordnance Corps.

That's why you find Bristol Electronic Dynamaster* Pyrometer Controls at U.S. Hoffman Machinery Corporation's Scranton, Pa. plant—the world's largest hot-forge shell installation.

Rotary furnaces, built by George J. Hagan Co., heat the steel billets. Bristol control systems, using round-chart Bristol Dynamaster Pyrometers, continuously monitor and regulate the heat in three zones in each of these furnaces.

After forging and before machining, the shells are heat treated in a two furnace setup. Surface Combustion furnaces, also controlled by Bristol Pyrometers, heat the shells in the first stage before quenching, and second stage after quenching.

Bristol Series 536 Free-Vane* Electronic Pyrometers automatically cut off the oil in case of furnace overheating.

Bristol Pyrometers provide precise temperature control for any industrial heating installation. You'll find complete specifications and prices in Bulletin P1260. Write for your copy today. The Bristol Company, 123 Bristol Road, Waterbury 20, Connecticut. 6.64

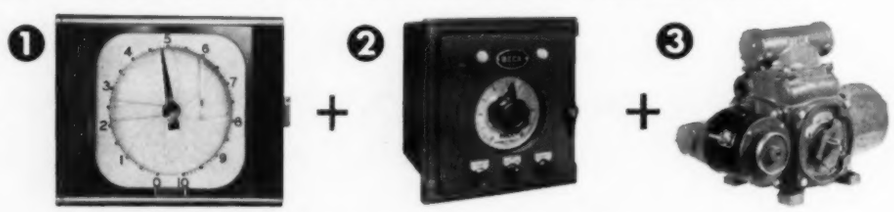
T. M. Reg. U. S. Pat. Off.

Here are the basic elements for finer temperature control. Hundreds of variations available.

1. Bristol Round-Chart Dynamaster Electronic Pyrometers.

2. Control relay.

3. Motor operator—for proportional positioning of final control units, such as valves, burners, rheostats.



There's a Bristol Controller for every furnace and oven.

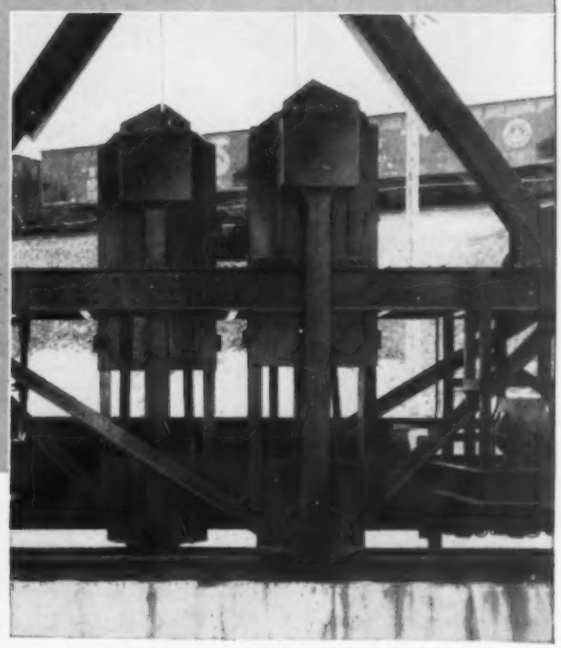
BRISTOL *TRAIL-BLAZERS IN PROCESS AUTOMATION*

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

MAKE SURE YOUR NEXT BULK MATERIALS UNLOADER HAS THESE IMPORTANT DRAVO FEATURES:

- Liberal Use of Welded Components
- Greater Rigidity of Structure through Use of Rolled Sections
- Fully Equalized Loading on Truck Wheels
- Trolley Accident Prevention with Dravo Hydraulic Buffers
- Use of Unit Construction for Mechanical Elements

POSITIVE WIND PROTECTION WITH DRAVO RAIL CLAMPS



Dravo Rail Clamps provide positive clamping of the unloader to its runway rails and will hold in winds having velocities over 100 miles per hour. No adjustments necessary to keep clamps in working order.

DRAVO Automatic Rail Clamps

keep unloaders safe in winds above 100 mph

Dravo-designed Automatic Rail Clamps provide positive clamping and never need adjustment. Many other such features result from the fact that . . . Dravo bulk materials handling equipment is individually designed to handle each specific job economically, dependably and *safely.* Such performance is achieved by bringing together the customer's operating knowledge and the experience of Dravo's research, design and construction men.

This method has resulted in high efficiency unloaders and other bulk materials handling equipment that produce because they are tailored to fit the job. Dravo engineering features, built into every structure, provide for low maintenance and operating costs. For complete information on unloaders or ore bridges write to Dravo Corporation, Pittsburgh 25, Pa.

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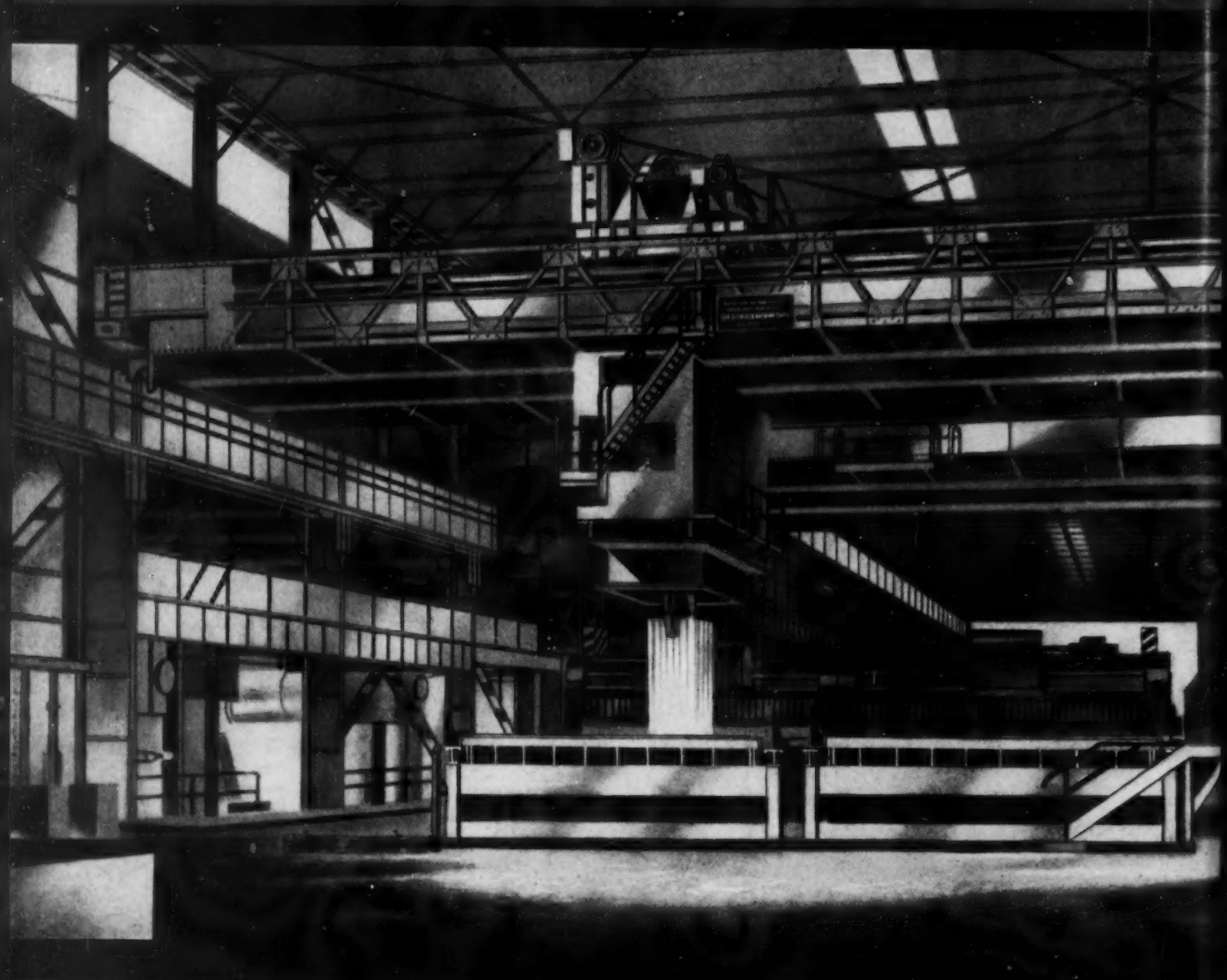
Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation

INTENSIFIED GRIP...



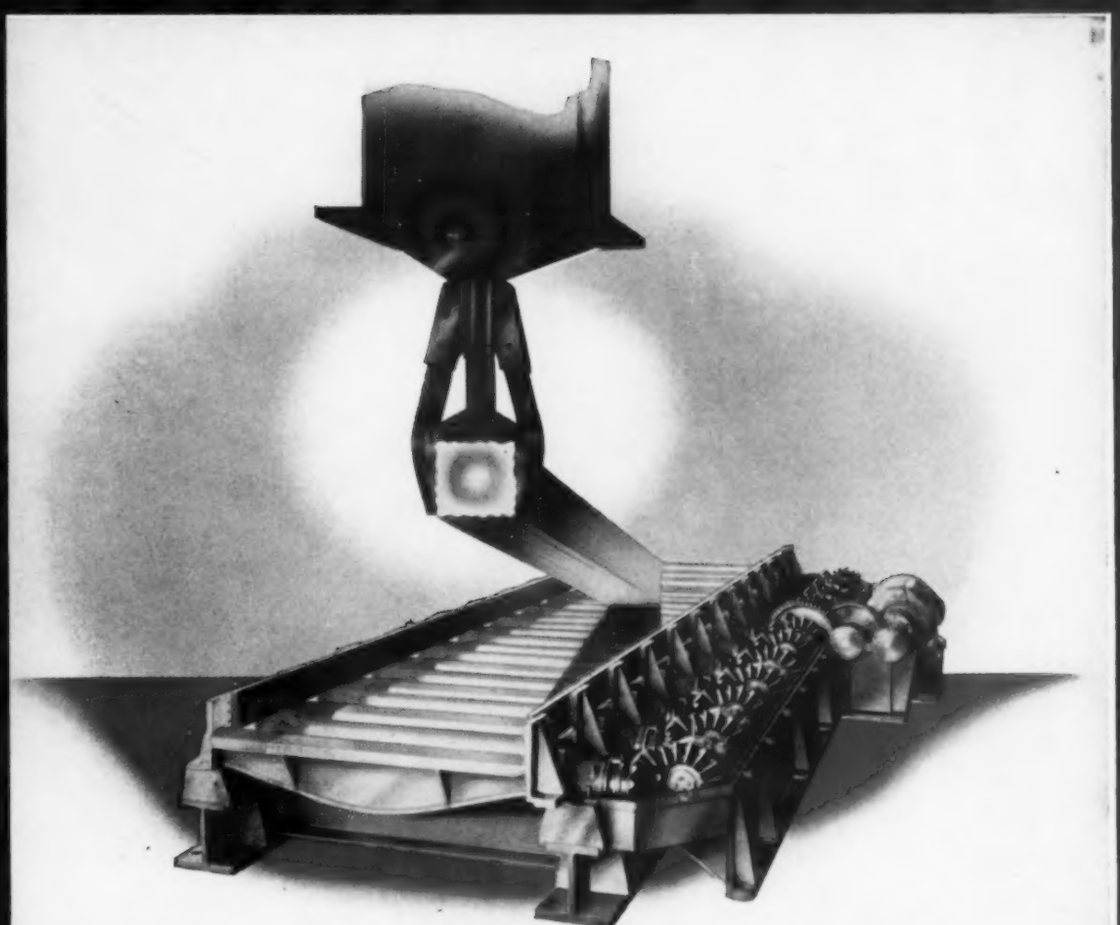
The tong grip of the conventional soaking pit crane depends *solely* on the weight of the ingot and when the weight of the ingot is removed, as in the case of placing an ingot on an approach mill table, the grip is reduced to zero and the ingot drops.

The tongs' grip of the Alliance intensified grip soaking pit crane *is* produced by the weight of the column *plus* the weight of the ingot. Since the weight of the column is usually equal to the weight of the ingot, the intensified grip soaking pit crane has the same grip *without* an ingot in the tongs as a conventional soaking pit crane has with an ingot, and *twice as much grip* as the conventional soaking pit crane when handling an ingot.

These intensified grip soaking pit cranes are built to handle ingots of any size and weight and incorporate all modern safety features. We welcome the opportunity to assist in solving your material-handling problems.

THE ALLIANCE MACHINE COMPAN

for Soaking Pit Cranes



The intensified grip soaking pit crane was developed by The Alliance Machine Company to hold ingots more firmly in the tongs and prevent dropping of ingots when they are placed on the mill approach table, ingot chariot or in the soaking pits. This is an exclusive Alliance feature.

Alliance

LADLE CRANES • GANTRY CRANES • FORGING MANIPULATORS • SOAKING PIT CRANES • STRIPPER CRANES • SLAB AND BILLET CHARGING MACHINES • OPEN HEARTH CHARGING MACHINES • SPECIAL MILL MACHINERY • STRUCTURAL FABRICATION

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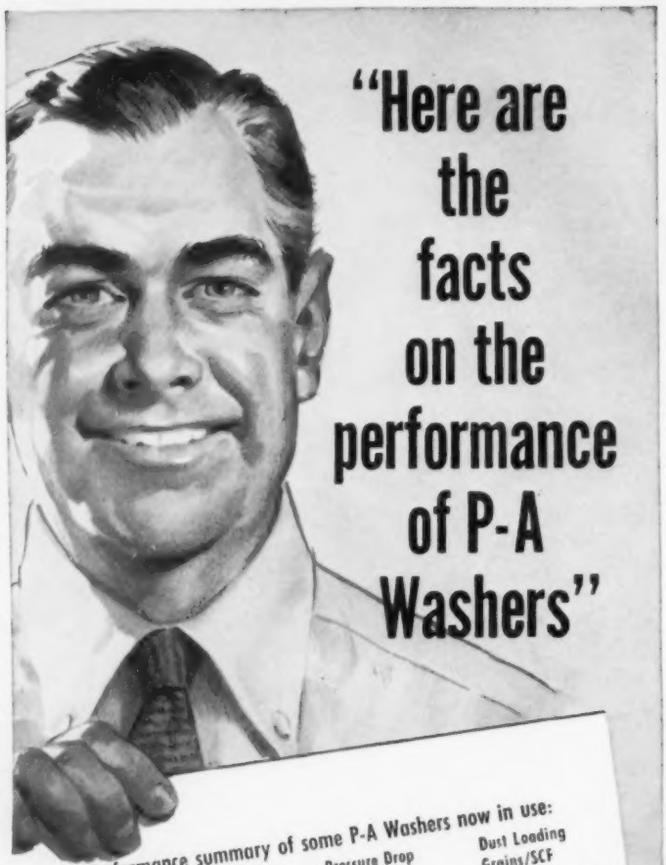
THE WORLD'S LARGEST BUILDER OF THE WORLD'S LARGEST CRANES



"Here are the facts on the performance of P-A Washers"

Performance summary of some P-A Washers now in use:

Installation	Years Operated	Volume SCFM	Pressure Drop Inches Water	Dust Loading Grains/SCF Inlet	Outlet
A	4	78,000	30	3-19.0	.01-.04
B	3½	78,000	30	2-3	.02-.08
C	3	85,000	30-40	2-3	.01-.03
D	3	45,000	30	2	.02-.03
E	½	75,000	50	—	.02
F*	½	26,000	12	5	.10
G*	½	26,000	12	5	.10
H	½	90,000	29	—	.04

*Two units in parallel on one furnace. Lower efficiency due to lower available top pressure

These actual performance figures reflect the highly efficient operation of the Pease-Anthony washer. This venturi scrubber puts your full top pressure to work cleaning the gas. No secondary cleaner required for most installations. Present users report no maintenance problems. If you have a blast furnace scheduled for construction or rebuilding, plan now for P-A Venturi installation. Capacities up to 150,000 SCFM. Write for bulletin M-103.

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Grabs for Handling Sheets and Coils

Since 1923, Mansaver's engineers have been developing grabs for every handling need. Mansaver has over 500 different grabs—a style for almost every requirement. The widest or the narrowest object always receives the same positive support. Styles are available for handling sheets, coils, extrusions, weighing from 2,000 to 200,000 pounds.

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Thousands of plants in various industries here and abroad use Mansaver Grabs for lifting steel, brass, aluminum, paper, and other materials, in mills, factories, warehouses.

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TYPE "CR" RADIAL WHEEL FAN FOR SEVERE INDUSTRIAL SERVICE

3 WHEELS TO MATCH YOUR PRESSURE-VOLUME NEEDS

The Type "CR" Radial Wheel Fan is one of a series of "Buffalo" Fans to blanket ALL the varying requirements for mechanical draft and heavy industrial service in today's plants.

The "CR" has the high-pressure, wear-resistant characteristics so necessary for handling dust-laden air or draft service on stoker fired boilers. It also makes possible selection of a smaller fan for many direct-connected applications — saving first cost. All this plus money saving mechanical efficiency.

- resistance to abrasion
- excellent dampered performance
- rising pressure characteristic
- lower first cost

In addition to the "CR", you may select a "BR" for higher capacity, lower pressure work — or a "DR" for higher pressure, lower capacity requirements — all in this long-lasting radial wheel series. And for inlet box volume control, these fans may be ordered with "Buffalo" Cantilevered Variable Inlet Vanes. These Vanes do not reduce open-position performance because there is no linkage or sources of turbulence on the inlet side. Write for Bulletin FD205 and see the "Q" Factor* that makes these fans a best buy for you!

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

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BUFFALO, N. Y.

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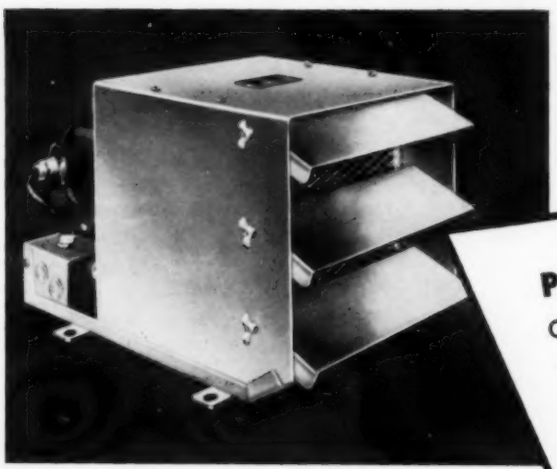
"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

instant heat where

you want it...WITH THESE TWO

P-G CONVECTION HEATERS



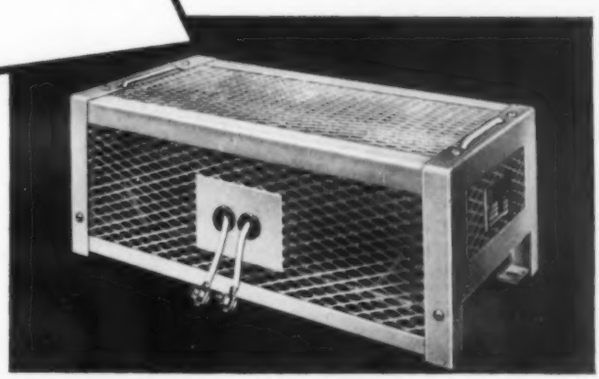
P-G Forced Convection Heater

Capable of moving a large volume of air with little noise. A 250 Volt D. C. Compound Wound Ball Bearing Motor of ¼ H. P. drives the fan. The heating circuit is controlled by a separately mounted 50-Ampere Magnetic Contactor energized thru a snap switch. The fan circuit is controlled thru a snap switch and contains a rheostat to vary the fan speed. Heating elements from 4 to 9 KW capacity, 230-250 Volts, D. C., are available.

P-G Natural Convection Heater

Ruggedly constructed, yet light in weight, they are easily portable by repair or construction workers. Ideal for permanent wall or floor mounting in crane cabs, etc. If a portable unit is desired, its disappearing handles may be used for ease in carrying. Made regularly in 3 to 6 KW capacity, 250 Volts, D. C.

TWO TYPES of HEATERS are available for industrial service. The heating element of both units is made of P-G Type T2, Chromium Steel Grids, which, because of their thin cross section, develop an unusually large heating area. A greater volume of warm air is so produced, and in addition, a more uniform heat distribution is obtained.



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The Nonbreakable Steel Grid Resistor

P-G

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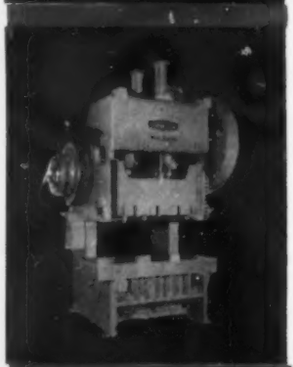

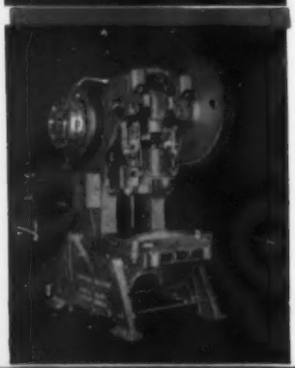

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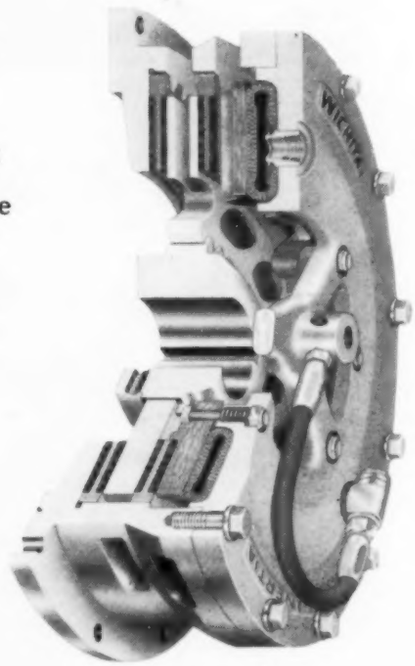
Take your pick of any Johnson Press using an air clutch and you'll find it is equipped with a WICHITA CLUTCH. WHY? Because WICHITA CLUTCHES have become standard equipment at Johnson.

After considerable checking and testing, Johnson engineers found that WICHITA CLUTCHES did more for their presses than any other known clutch. WICHITA offers a clutch in which there is (1) Extremely fast engagement and disengagement; (2) Positive air cooling; (3) No adjustments required; (4) No lubrication required; (5) Complete freedom from effects of centrifugal force; (6) Quicker action with less power consumption; (7) Less consumption of air. ¶ Investigate WICHITA... You'll find WICHITA offers clutches and brakes of greater efficiency in all sizes ranging from 2,000 in. pounds to 3,000,000 in. pounds. CONSULT A WICHITA ENGINEER... TODAY.



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Elkhart, Indiana

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L. H. Fremont, Cincinnati, Ohio
W. G. Kerr Company, Pittsburgh, Pa.
Smith-Keser & Co., (Main Office), Avon Conn.
Smith-Keser & Co., Philadelphia 44, Pa.
Smith-Keser & Co., New York, New York
Frank W. Yarline Co., Chicago, Ill.
Larry W. McDowell, Long Beach, Calif.
Andrew T. Lobel, Denver, Colorado
Robert R. King Co., Cleveland, Ohio
Dominion Power Press Equipment Ltd., Burlington, Ontario, Canada
Allied Transmission Equipment Co., Kansas City 8, Missouri
R. E. Kunz, Seattle, Wash.
W. G. Ballantyne & Co., Portland, Ore.
Norman Williams, Houston, Texas

Personnel News...

Chalmers C. McElvain was named manager of the Baltimore Works, Armco Steel Corp., succeeding **G. D. Moomaw,** who is retiring from active service after 45 years in the steel business. Mr. McElvain was named assistant manager of the Baltimore Works in January. He has held industrial engineering positions at Armco's general office in Middletown, Ohio, and its Butler, Pa., steel works. He joined the Baltimore organization as works industrial engineer in 1945. He retained that responsibility when he was made administrative assistant to the manager in 1955. Mr. Moomaw has been manager of Armco's Baltimore stainless steel plant for the past 18 years. He was employed by the Stark Rolling Mills in 1912, where he worked as a furnace helper. Later he went into maintenance and engineering. In 1926, he joined Crucible Steel Co. in Pittsburgh and subsequently took over the management of their tool steel plant at Syracuse, N. Y. In 1939, as manager, he joined the Baltimore Stainless steel plant—then the Rustless Iron and Steel Corp. The company became a part of Armco in 1945.

J. D. Dickerson was named to the newly created position of manager—steel production, of Crucible Steel Co. of America. Mr. Dickerson had been staff assistant to **L. L. Ferrall,** vice president—operations, to whom he will continue to report. Before joining Crucible, Mr. Dickerson held various metallurgical positions with Republic Steel Corp. at Buffalo, N. Y., from 1933 to 1953, his last position being that of chief metallurgist.

John D. Saussaman has been appointed division superintendent in the Iron and Steel Division at the Kaiser Steel Corp., Fontana, Calif. He previously served as superintendent of the plant's three blast furnaces. Mr. Saussaman came to Kaiser Steel in 1946 as assistant superintendent of the blast furnaces. He was named superintendent two years later. He was previously employed by Carnegie-Illinois Steel Corp. following his graduation from college.

C. W. Barrett has been appointed manager of the southern district of Republic Steel Corp., replacing **E. I. Evans,** who is retiring. **H. H. Northrup** has been named to succeed Mr. Barrett as manager of Republic's Buffalo district. **E. W. Carlson,** formerly superintendent of bar mills, at Republic's Cleveland steel plant, will take Mr. Northrup's place as assistant district manager at Buffalo. Mr. Barrett came with Republic in 1943 and for several years was the company's chief roll engineer, in 1952 he was made assistant district manager of the Buffalo district, and in 1954 was appointed manager of the Buffalo district operations. Before coming with Republic, Mr. Barrett worked for Carnegie Steel Co. in the general engineering department and later worked for Mackintosh-Hemphill Co. on heavy rolling mill design. He was employed in a similar capacity by Pittsburgh Rolls Co., for nine years before joining the Dominion Steel and Coal Corp., Sydney, Nova Scotia, as superintendent of roll shops.

Mr. Northrup joined Republic in 1935. In 1942, he moved to the Buffalo steel plant as assistant superintendent of the open hearth department. In 1947 he was named superintendent of the department and in 1954 became assistant district manager. Mr. Carlson joined Republic as machinist at the Chicago district steel plant in 1939. In 1947, he was named mechanical foreman at the bar mills there and three years later was appointed assistant superintendent of maintenance. He became assistant superintendent of bar mills in 1950. Five years later he was named superintendent of bar mills in Cleveland.

John A. Eckel formerly assistant to the general superintendent, Fairless Works, has been appointed to the position of assistant to the general manager—steel operations, U. S. Steel Corp., with headquarters in the corporation's Pittsburgh offices. Mr. Eckel started with U. S. Steel as a metallurgist for American Sheet and Tin in 1929. In 1936, he went to Gary Sheet Mill as a metallurgist, serving in this capacity until 1947, when he was made superintendent of galvanizing of the sheet mill. In 1949, he was appointed chief metallurgist of the plant—the capacity he maintained until his transfer to the Fairless Works.

Tom M. Girdler, Jr., has been appointed manager, Union Drawn Steel Division, Republic Steel Corp., succeeding **D. D. (Buck) Buchanan,** who has retired. **H. B. Anderson,** superintendent of Union Drawn's

C. C. MC ELVAIN

J. D. DICKERSON

J. D. SAUSSAMAN

H. H. NORTHROP

R. S. GRUVER

C. G. DAVIES

J. A. ROEMER

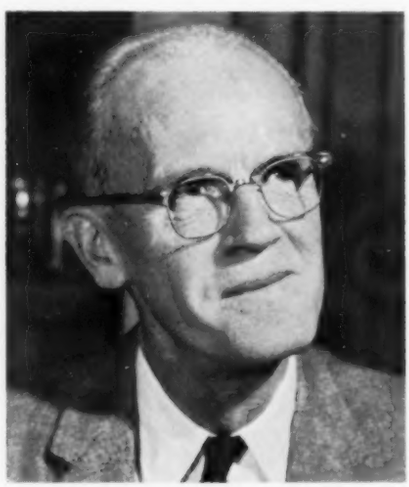
A. M. TREDWELL, Jr.

Beaver Falls, Pa., plant, has been named assistant division manager succeeding Mr. Girdler. Although Mr. Buchanan has been associated with the steel industry for 54 years, his career with Union Drawn began when he was named manager of the company's Beaver Falls Plant No. 3 in 1924. Six years later he was appointed assistant general manager for Union Drawn at the company's headquarters in Massillon, Ohio, and in 1938, he was named division manager, the position from which he retired. Mr. Girdler joined Union Drawn in 1945, and was named assistant superintendent of the company's Beaver Falls plant in 1947, and superintendent in 1949. He was appointed to the newly created position of assistant manager of operations for Union Drawn in 1952. Mr. Anderson has been associated with Republic for more than 20 years. He joined Union Drawn as an industrial engineer in 1941 following service with Republic's Berger, Bolt and Nut, and Truscon Divisions. He was appointed assistant superintendent of Union Drawn's Massillon plant in 1945, and in 1952, was named superintendent of the Beaver Falls plant, succeeding Mr. Girdler.

Robert S. Gruver was named administrative vice president in charge of personal and public relations, Armco Steel Corp. He was formerly administrative vice president in charge of the operations of the Armco Division of the company. He succeeds **Charles H. Murray,** who is retiring after 45 years with Armco. Mr. Murray, who became a vice president in 1947, will continue to serve the company as a consultant. **Clyde G. Davies** succeeds Mr. Gruver as vice president in charge of operations of the Armco Division. He has been assistant vice president. Also **R. G. Adair** and **H. W. Wright** were named assistant vice presidents. Mr. Adair, who has been director of personal relations for the company, has been elected assistant vice president, personal relations. Mr. Wright, formerly director of public relations, becomes assistant vice president, public relations.

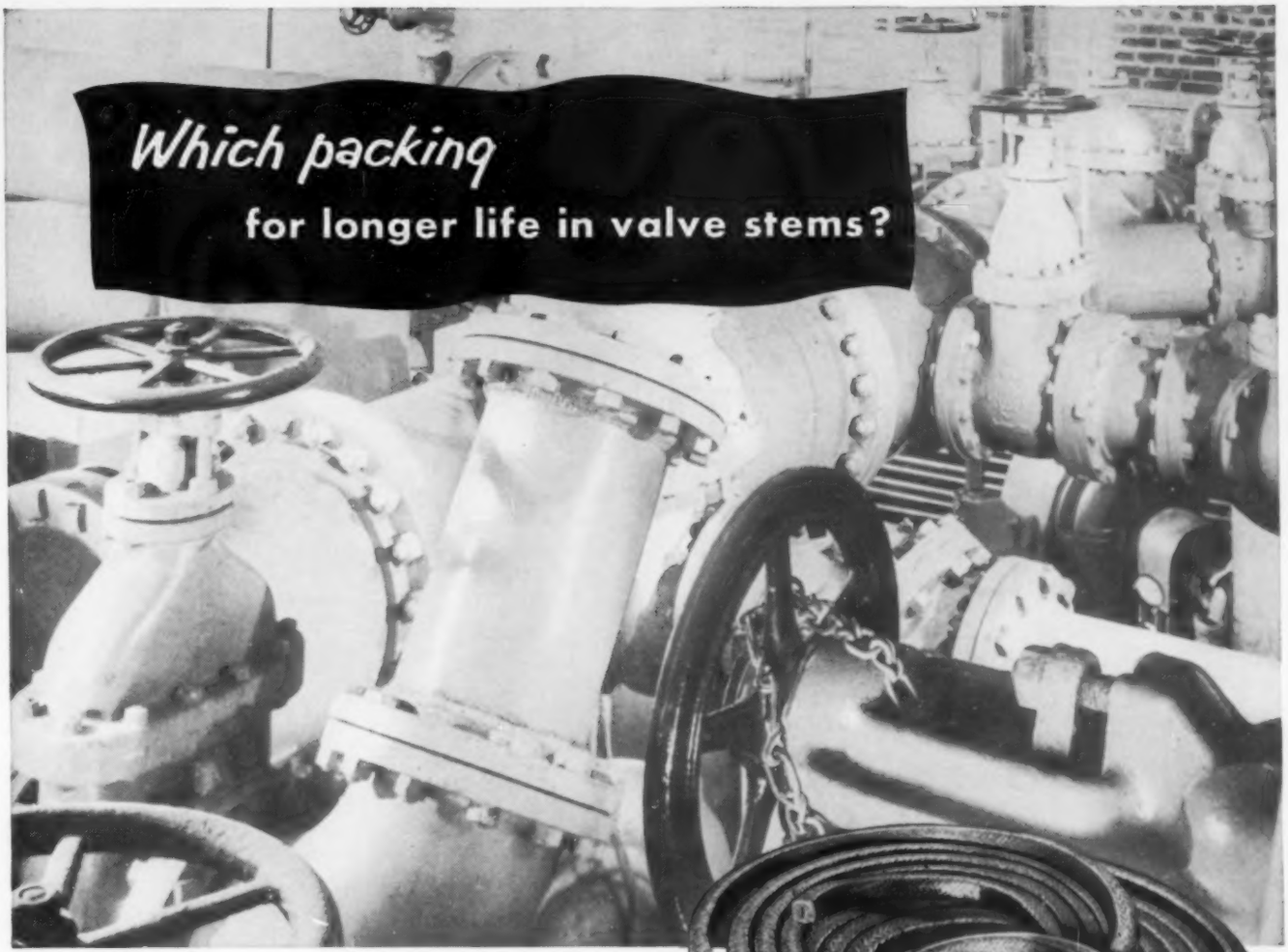
Henry A. Roemer has relinquished his posts as chief executive officer, chairman of the board and president of Sharon Steel Corp., but will continue as a director and chairman of the company's executive committee. Succeeding him will be **James A. Roemer,** president of Mallory-Sharon Titanium Corp., who was elected Sharon's chairman of the board, and **Alfred M. Tredwell, Jr.,** who was elected president. Mr. Tredwell, formerly vice president in charge of operations, was also elected a director and member of the executive committee. **James A. Roemer** will continue as head of Mallory-Sharon. Another change was the election of **Wilbur T. Blair,** vice president in charge of finance and treasurer, to the board of directors.

William H. McComb was named plant manager, Ambridge Plant of U. S. Steel's American Bridge Division, succeeding **Oscar Seidel,** retiring. At the same time **James A. Dunn** was named general plant superintendent. Mr. McComb joined United States Steel Corp. at the Gary, Ind., plant of American Bridge Division in 1916 as a rate clerk. Two years later he advanced to assistant industrial engineer and in 1937



W. H. MC COMB

was named industrial engineer at the Ambridge Plant. In 1943 he was appointed assistant manager of the Shipyard Division, Ambridge. He served as assistant to manager, Ambridge Plant, in 1946 and in 1947 was appointed general plant superintendent, his position prior to his new appointment. Mr. Dunn began his U. S. Steel service with American Bridge Division in 1937 as a draftsman. In 1939 he became a foreman in the barge yard, Ambridge Plant, and two years later



. . . for heavy fluids, steam, water and gas . . . *it's J-M Jewett*®

Strong, tough Jewett has been proven the ideal packing for heavy duty valve stem service against crude and heavy oils, tar, molasses and other heavy gummy fluids. It also provides efficient sealing against steam; fresh or salt, hot or cold water; air; gas and some chemicals requiring a packing free from rubber.

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To obtain this high sealing efficiency, Johns-Manville braids asbestos yarn of high purity over a plastic core of special heat resistant composition. For extra strength, the yarn is reinforced with tough heat and corrosion resistant Inconel wire. The packing is formed square and then lubricated with graphite. Furnished in ring, coil and spiral form in sizes ¼″ to 1″.

Your local J-M distributor carries full stocks of Jewett, High Temperature and other packings. Call him today or write Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

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JM

Eases toothless saw through toughest steel in seconds

Louis Allis motor powers high-speed steel cutter

Powered by a Louis Allis 200-hp high-torque squirrel cage motor, the friction saw shown above zips through steel like a hot knife through butter. The blade-edge, traveling at more than 300 miles per hour, generates enough frictional heat at the point of contact to actually *melt* its way through an 8 in. steel pipe section in 3.25 seconds — a 100 lb. rail in 4 seconds — a 12 in. I-beam in 5.7 seconds.

These extremely high cutting rates and the hydraulic carriage drives of these machines require high torques subjecting the motors to severe loading conditions. That's why the manufacturer of this heavy-duty friction saw selected Louis Allis motors for dependable power supply to blade and carriage drives.

Whether it's for cutting steel or for any other demanding application, Louis Allis can provide the motor you need. Our engineers will help you select the exact rating, speed, and enclosure your job requires. What's more, they can recommend electrical and mechanical modifications that may improve your operation, reduce costs, and provide long, trouble-free motor life.

For facts or engineering assistance, contact your nearby Louis Allis District Office. Or write The Louis Allis Co., 450 E. Stewart St., Milwaukee 1, Wis.

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was appointed assistant superintendent, marine building. In 1942 he was named superintendent, marine building, and four years later advanced to superintendent, main shop. He went to the Division's Trenton, N. J., plant in 1956 as plant manager, the position he held prior to his new appointment.

R. A. Kraus has been recently promoted to superintendent of Mechanical Maintenance, Republic Steel Corp., Chicago. Mr. Kraus formerly was assistant superintendent of maintenance at the Chicago plant.

N. W. Blakely has been named assistant general manager of Wheeling Steel Corp.'s Benwood, W. Va., Works. He has been with Wheeling Steel since 1951 when he was appointed assistant chief plant engineer of the Steubenville Works. Two years later, he was made chief plant engineer at Steubenville. In 1955, he was put in charge of the major construction program at the Steubenville and Yorkville, Ohio, plants.

L. W. Moore has been appointed assistant general manager of Wheeling Steel Corp. Steubenville, Ohio, Works. Mr. Moore has been with Wheeling Steel since 1953, starting as a general turn foreman in the open hearth department at the Steubenville Works. In 1954 he was made superintendent of the open hearth department. Early this year he was appointed assistant to the general manager, Utilities and Development.

Lee F. Weitzenkorn was appointed assistant to the works manager of Armco Steel Corp.'s Baltimore Works. Formerly Armco's works metallurgist, Mr. Weitzenkorn will co-ordinate the steel works quality control and develop improved processing procedures. **John S. White** has been promoted to the position of works metallurgist. He was formerly supervising metallurgist.

William E. Brandt has been appointed to the position of assistant division superintendent of steel production at the Fairless Works of United States Steel Corp. Mr. Brandt fills the post recently vacated through the promotion of **John D. Sutherland** to the position of division superintendent of the open hearth department at U. S. Steel's Homestead Works. Mr. Brandt started his career with U. S. Steel in 1939 at the Homestead, Pa., Works in the open hearth department. Mr. Sutherland came to Fairless Works in November, 1955, as assistant division superintendent of steel producing from U. S. Steel's Youngstown, Ohio Works, where he started his steel career in 1940 as a metallurgical observer.

Edward C. Leibig has been elected president of Corhart Refractories Co., Inc. He succeeds **Hugh L. Kline** who has been appointed field sales manager of the Television Sales Department at Corning Glass

E. C. LEIBIG

Works, parent company of the wholly owned subsidiary. Mr. Leibig will continue to serve as general manager of the Refractories Division at Corning. He has been a member of the Corhart board of directors since last spring.

Dr. Edgar C. Bain, assistant executive vice president—operations, United States Steel Corp., retired September 30, after nearly 30 years of service with the corporation. He began his career with U. S. Steel in 1928 as head of the Research Laboratory at Kearny, N. J. He served there until 1935 when he became assistant to vice president of U. S. Steel Corp. In 1943 he was named vice president—research and technology of Carnegie-Illinois Steel Corp. In addition to retaining this title in U. S. Steel Corp. upon its reorganization in 1952, Dr. Bain was also appointed chairman of the

R. A. KRAUS

N. W. BLAKELY

L. W. MOORE

L. F. WEITZENKORN

A. H. CLARKE

R. P. NORTHUP

M. P. ORR

R. B. MCCARTHY

Research Policy Committee. He assumed his present duties as assistant executive vice president—operations on July 1, 1956.

Roy E. Hum was promoted from assistant superintendent of maintenance, to superintendent of maintenance at Brier Hill Works of Youngstown Sheet and Tube Co. **William G. McCollum,** who had been general foreman of the coke plant, was promoted to assistant superintendent of maintenance at Brier Hill.

Albert H. Clarke, former vice president for engineering, Crouse-Hinds Co., has been named vice president for manufacturing. His successor as vice president for engineering is **Russell P. Northup,** formerly commercial vice president for condulet sales. **John B. Crosby,** assistant to the president, succeeds Mr. Northup as condulet sales manager, and **William A. McAuley** becomes new products manager in the sales division.

Marquis P. Orr has been appointed manager of roll sales for E. W. Bliss Co.'s Mackintosh-Hemphill Division. Mr. Orr joined Mack-Hemp in 1941 in an internal sales capacity, and later became a roll engineer. Prior to his present appointment he was assistant manager of roll sales.

R. B. McCarthy was named chief engineer of the Steel Mill Division, Surface Combustion Corp. Mr. McCarthy has been with Surface for nine years. His early experience with the corporation was in the Erection Department working on the operation and construction of all types of steel mill equipment. In January of this year Mr. McCarthy was promoted to assistant chief engineer, Steel Mill Division, which led to his current appointment.

Kenneth H. Meyer, was named director of engineering, C. B. Hunt & Son, Inc., succeeding **C. S. Chessman,** resigned. After four years as senior development and project engineer at Goodyear Aircraft Corp., Mr. Meyer joined C. B. Hunt & Son in 1954 as assistant chief engineer.

K. H. MEYER

1—34" REVERSING HOT STRIP MILL CONSISTING OF:

1—Slab re-heating furnace 44" wide x 93'4" long, 4 heating zones, oil and gas burners.

1—Mill drive motor, reversing, 2500 HP, 75/150 RPM, 600 volt D.C., with controls.

1—28" x 40" 2-high reversing mill having Morgoil bearings in roll stand, Timken bearings in pinion stand, universal spindles with carriers, 75 HP motor screwdown.

2—Re-heating coiling furnaces, each 50" wide, for gas or oil fuel, for coiling and uncoiling strip under tension while being rolled to thinner gauges.

1—Delivery table, 38" wide x 136'6" long, with anti-friction bearings. Speed 900 FPM.

1—Coiler 24" dia. driven by 100 HP, 485/1200 RPM motor. Timken bearings. Air push-off.

1—Coil discharge gravity conveyor 70'4" long.

1—Main motor-generator set for supplying reversing motor; also auxiliary generators.

All of the above equipment is in good operating condition, has been used very little. Further details will be furnished upon request.

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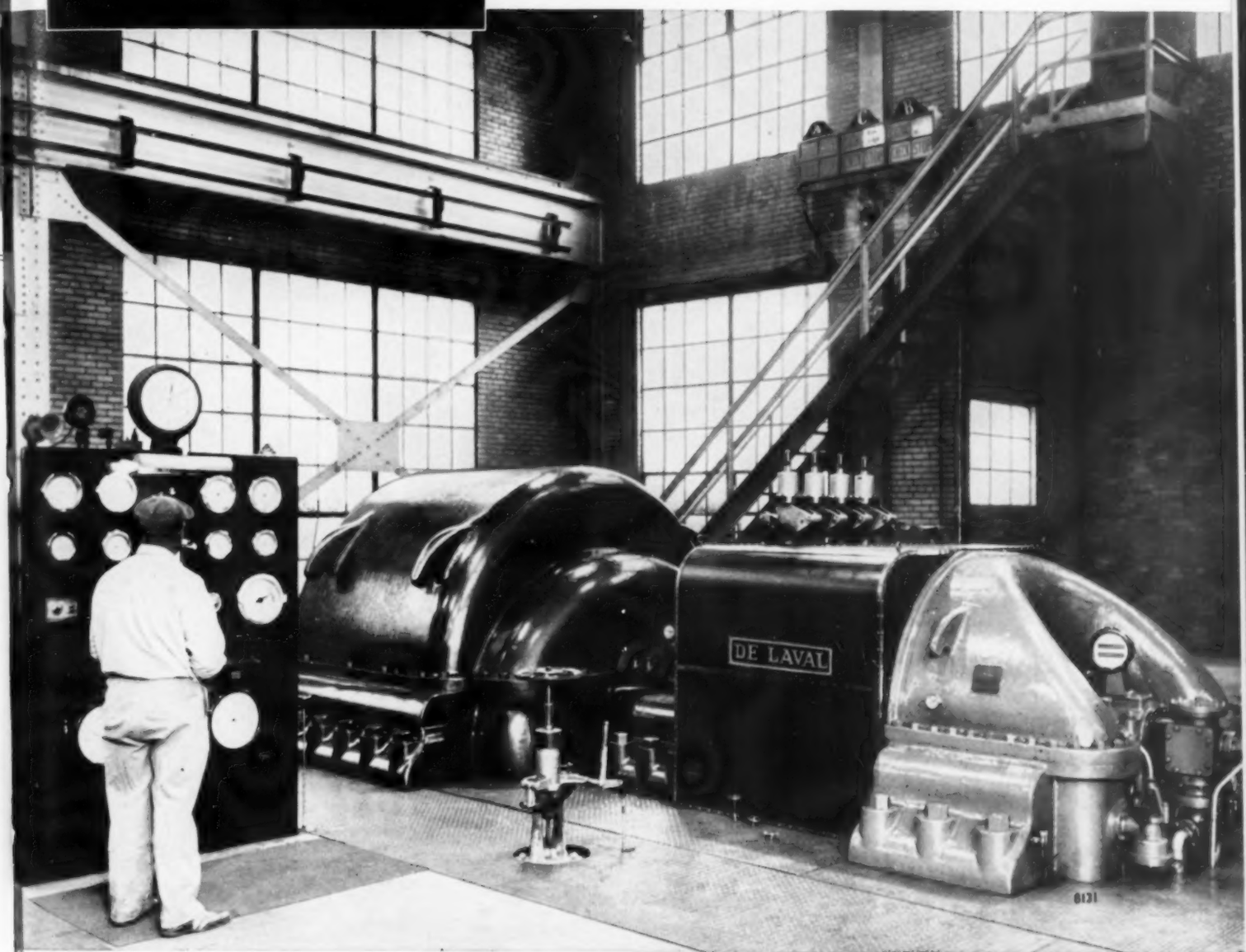
BLAST FURNACE BLOWERS

give 20 years of service at Great Lakes Steel Corp.



Shown is one of two De Laval centrifugal blast furnace blowers at the Ecorse, Michigan, plant of the Great Lakes Steel Corporation, Division of National Steel Corporation. This 85,000 cfm unit was installed twenty years ago; another 75,000 cfm unit went on the line a year earlier. Both have given dependable round-the-clock service ever since. These turbine-driven blowers are hooked up to a multi-head which enables either one to be used in conjunction with any of the three blast furnaces.

De Laval centrifugal blowers are built in single and multi-stage types to supply air in volumes up to 150,000 cfm for all classes of service in steel, gas and coke plants. The wealth of application experience acquired by De Laval over the years assures a correct and economical solution to your blower problem.

Send for Bulletin 0504

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DE LAVAL STEAM TURBINE COMPANY

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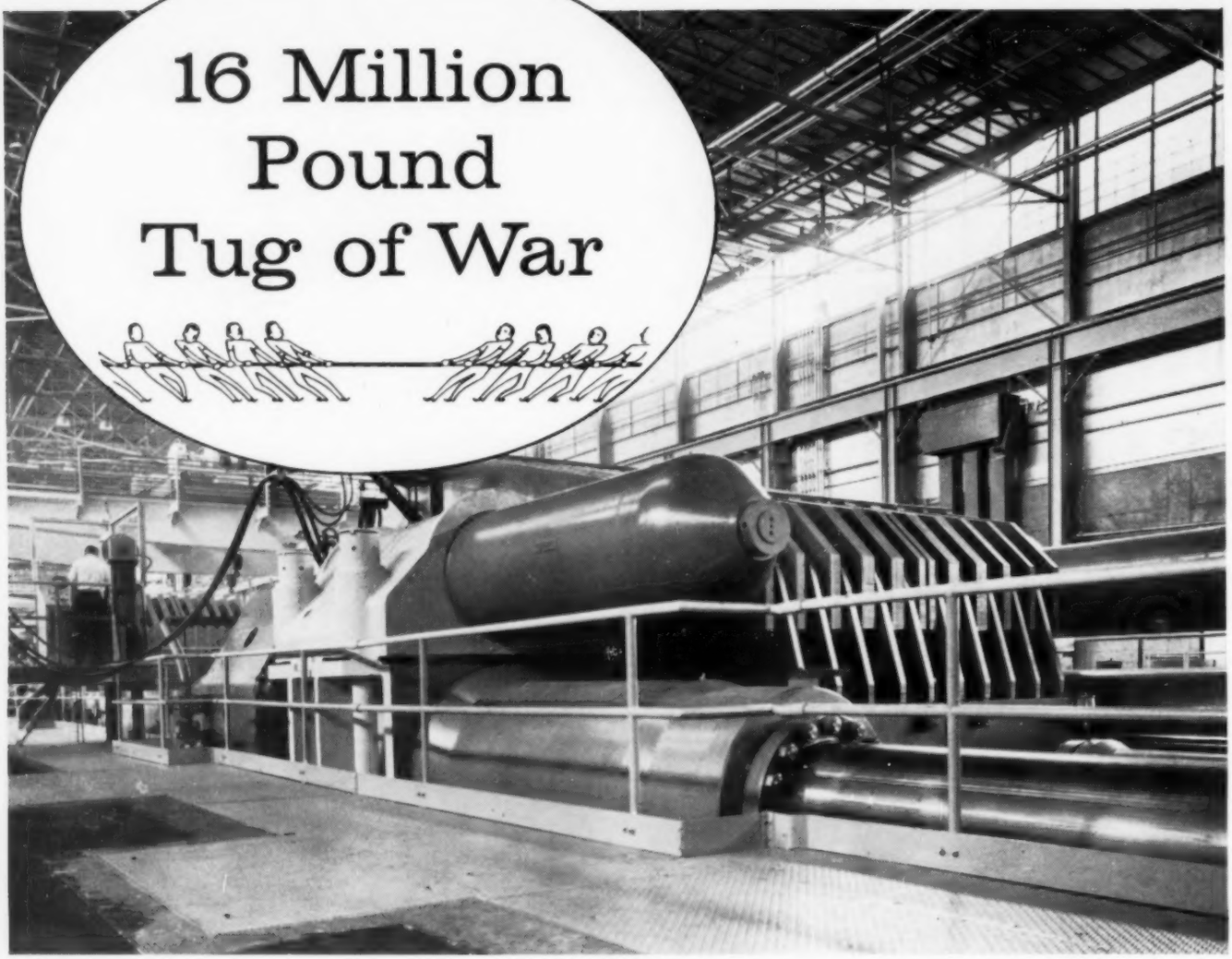
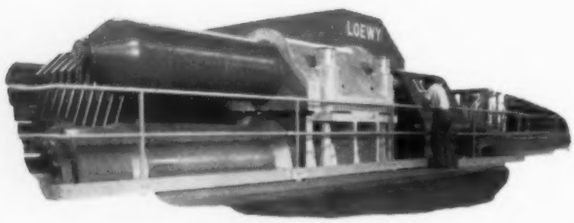
16 Million Pound Tug of War





Installed at Aluminum Company of America's Davenport Works

This 16-Million-Pound Stretcher, largest of its kind, is being used to straighten sheet and plate at *Aluminum Company of America's Davenport works.* The stretcher, operated by Alcoa for the Air Force is part of a $54-million expansion of facilities unveiled recently at the Davenport operations. The mill is now equipped with the biggest sheet and plate rolling facilities in the world.

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E. F. KURZINSKI

John Lindberg, former manager of manufacturing operations for E. W. Bliss Co.'s Mackintosh-Hemphill Division in Pittsburgh, has been named manager of the Canton Division. **Richard Y. Moss,** former Canton Division manager, has been named manager of special product sales. **Charles E. Peterson,** former chief metallurgist of the Mackintosh-Hemphill Division, has been promoted to the position of manager of manufacturing operations for Mackintosh-Hemphill, succeeding Mr. Lindberg.

Edward F. Kurzinski has joined Air Products, Inc., as manager of sales development engineering. He will assist both the ferrous and nonferrous metals industries, and other related industries, in their problems relating to the use of oxygen and other industrial gases. Mr. Kurzinski has several patents in the field of metallurgical processes and was previously Laboratory Division Head at the Linde Co.

K. J. Kenyon, formerly chief engineer, has retired from Algoma Steel Corp., Ltd., Sault Ste. Marie, Canada. He has been succeeded in all capacities by **James L. Laidlaw,** who has been given the title of manager of engineering. Mr. Laidlaw was formerly division superintendent, plant maintenance and services.

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Model PQ-6 for 3" pipe line available with screwed or flanged connections.

GEORGE MEANY

Portrait by Fabian Bachrach

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GEORGE MEANY, ***President***
American Federation of Labor—
Congress of Industrial Organization

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THE BROOKS OIL CO.

Lube-Engineering News

A REPORT ON THE DIFFICULT LUBRICATING PROBLEMS OF INDUSTRY

93% SAVING IN MILL TABLE LUBRICATION COSTS REPORTED BY LEADING STEEL PRODUCER

A leading steel producer recently went through a series of corrective measures to improve lubrication of mill tables. They went from circulating oil system to pressure grease system and finally to automatic spray system.

In the spray system, they used Brooks Klingfast and reported a saving of 93% in lubricant cost. They do not attribute the saving to the change in equipment, as various lubricants were tested. Klingfast offered the greatest reduction in lubricant cost for the application.

Records indicate a 35% decrease in man hours spent on this lubrication job, and 65% less maintenance delays, due to improved lubrication. Klingfast has proved itself against adverse conditions of mill scale, water and high temperatures. Savings in maintenance costs were coupled with increased production.

For full information, write for Engineering Letter 73IS.

NEW COLOR FILM AVAILABLE TO LUBE-ENGINEERING GROUPS

This new 30 minute 16 mm motion picture, in full color, with sound, shows a number of tough lubrication jobs. It pictures and describes the research, manufacturing and quality control methods that enable Brooks lubricants to "stand up" under severest service.

It's available to any supervisory or engineering group interested in lubrication problems. No charge, of course—we're glad to have you see it. Just call or write any of our offices and tell them you want to borrow "The Brooks Oil Story."

CIRCULATING OIL SYSTEMS REQUIRE LUBRICANTS THAT WITHSTAND SEVEREST SERVICE CONDITIONS

Dust, dirt, water and metallic contamination present extremely difficult problems for circulating oil system lubricants—in steel mills, forging and press shops, cement plants and many other industries. Lubricating compounds must withstand constant contact with contamination, readily dissipate such foreign matter and maintain quality for continued service.

Brooks Leadolene and Klingfast are compounded to meet such severe conditions. These products have served industry since the early 30's and have broken many records. Companies in the United States and Canada have obtained 5, 10, 15 and 20 years of continued service from these lubricants. For complete facts, see your Brooks representative or write for Engineering Letter 86IS.

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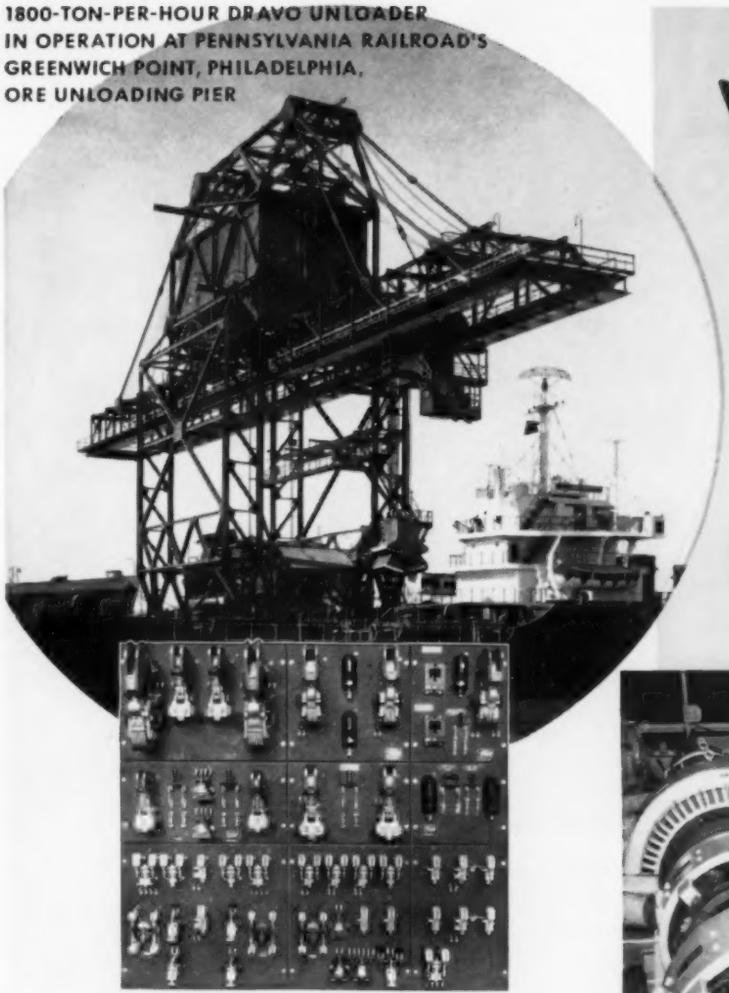
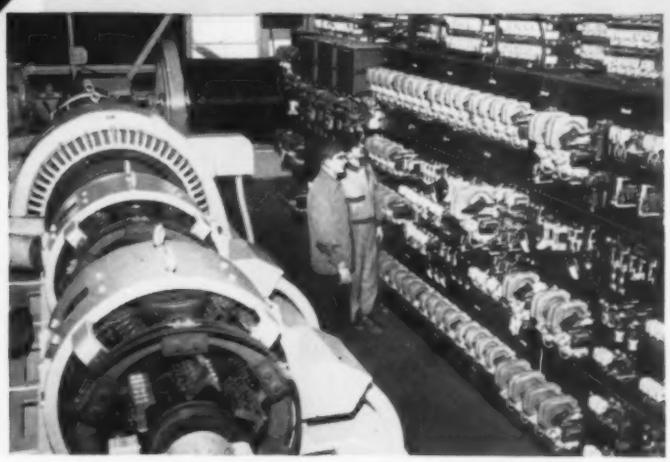
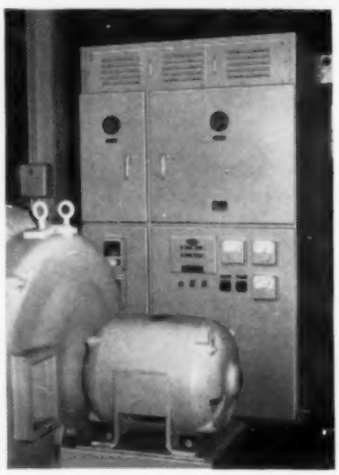


You're Under Way *Fast* WITH EC&M ADJUSTABLE VOLTAGE CONTROL!

EC&M Adjustable Voltage Control Panel *(mounted on trolley)* for Hold and Close Line Motors and for Trolley Motor, plus Protective Panel for other drives.



EC&M Control Panels for Hold Line, Close Line, Trolley, Turntable, Quadruplex Travel, Rail Clamps and Apron Hoist Motors are mounted in Machinery room, 100 feet above ground level, along with generators which supply DC power for unloader motors. Power resistors, mounted above Panels, are EC&M TAB-WELD.



EC&M Type ZHA 4160 Volt Starter provides pushbutton starting of 800 HP Elliott synchronous motor driving 4 generators.

This Dravo Unloader is typical of many prominent installations on which EC&M has worked with both unloader and motor builders to get machines into production quickly with minimum adjustment and "tune-up" time.

Equipped with a total of 20 motors ranging in size from 10 to 800 HP, this unloader takes giant-sized bites (22½ tons) of ore from a ship's hold on an average cycle handling time of 45 seconds. Frequently, the skilled operators lower the time to 36 seconds per trip.

The bucket (hold and close line motors) and trolley drive are operated by adjustable voltage control under current limit acceleration through rotating regulators. Constant potential control is used for the travel, rail clamps, turntable and apron hoist.

EC&M is prepared to supply complete equipment including control, brakes, limit stops and all rotating machinery. When planning adjustable voltage installations, consult EC&M for engineering assistance.

Photos courtesy Dravo Corporation, Elliott Company and the Pennsylvania Railroad

THE ELECTRIC CONTROLLER & MFG. CO.
A DIVISION OF THE SQUARE D COMPANY
CLEVELAND 28 • OHIO

EC&M'S 60TH ANNIVERSARY • 1897-1957

9104

"WHAT'S YOUR LINE?"

CHEMICALS, PRIMARY METALS, MACHINERY?

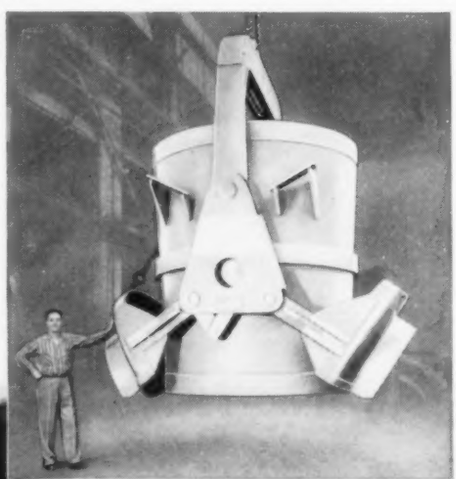
Special indexing machine tool base over ten feet in diameter, weight nearly ten tons.

You name it—and the odds are two to one that McGregor-Michigan is experienced in *your* line. We're turning out an endless miscellany of steel plate fabrications for industries across the nation. As part of the proof of our ability and versatility, here are a few of the products of the manufacturers and processors we're serving:

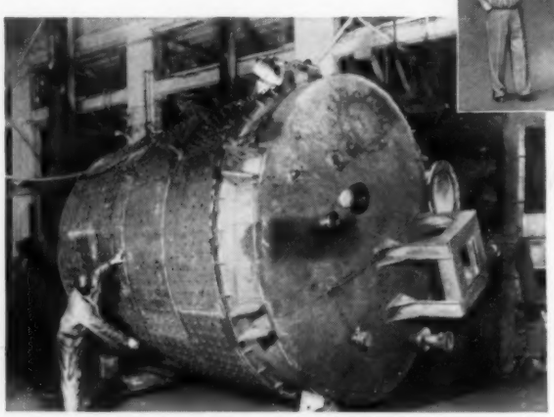
> Acids, alkalis, fertilizers, glass, refractories, plastics, petroleum, steel, aluminum, automation and special machinery, explosives, paper, diesels, cement and rock products, coke by-products, leather, soap, tools and dies, textiles—and numerous variations of these.

As further evidence of the reliability of McGregor-Michigan, we're proud to point out that the frequent repeat orders from these fine customers are the surest indication that we've earned their good will. How? By seeing that all factors are in balance: price, quality, delivery and service—for it is only by complete attention to *all* of these that we are able to fully satisfy our many diversified customers.

If you don't see your particular industry included in the list above, think of the many problems these customers have thrown at McGregor-Michigan —then go and do thou likewise.

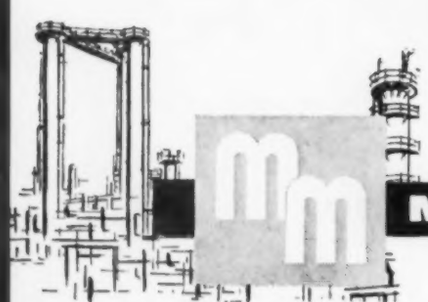


Steel mill scrap bucket. Linkage equalizes opening of clamshell halves.



Stainless steel jacketed chemical mixing kettle. Operates under vacuum and atmospheric pressure, medium high temperatures.

Send for new booklet showing equipment and typical steel plate fabrications.



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TRINITY 2-2400

STEEL PLATE FABRICATING AND WAREHOUSING

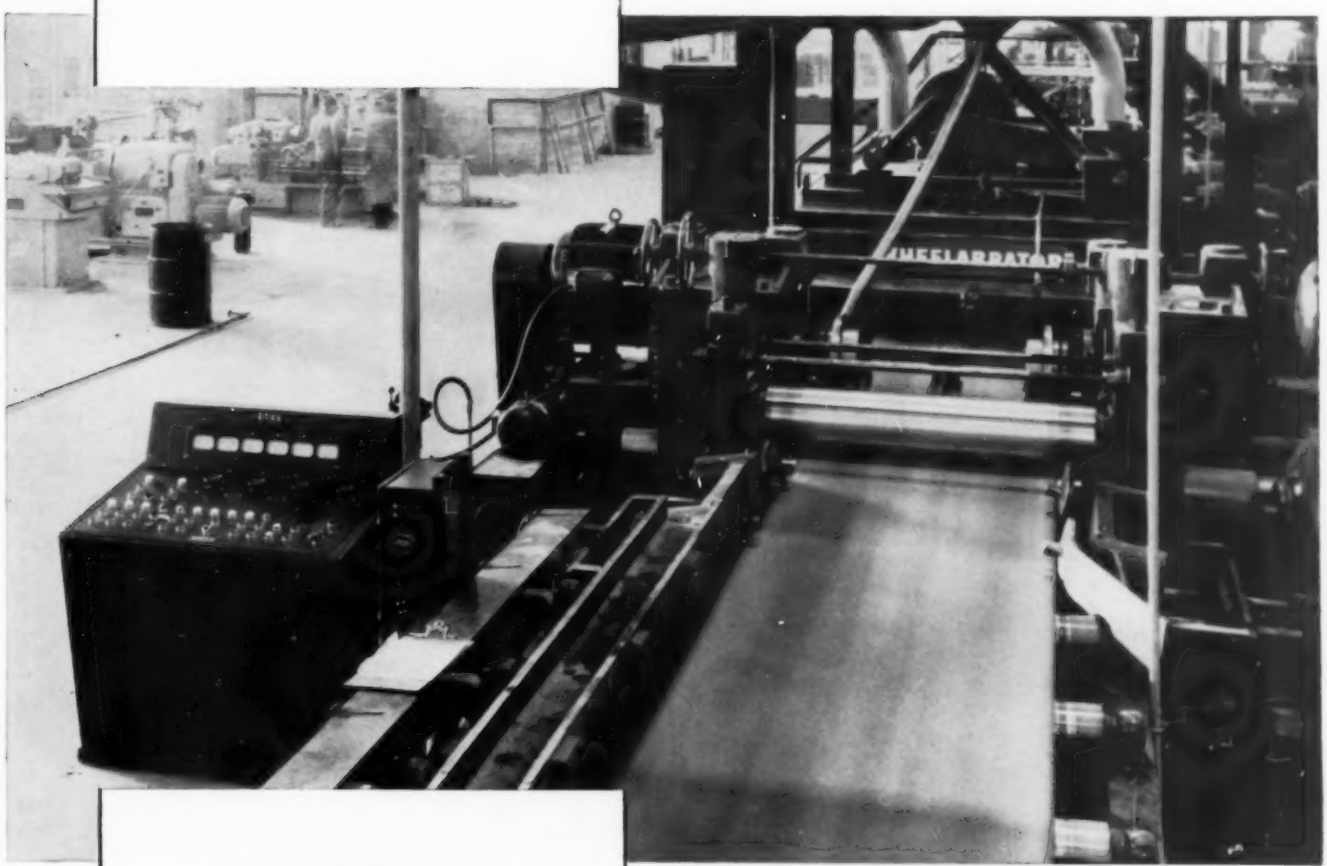
Canada's newest steel pipe mill, completely automated, features

PUSH BUTTON DESCALING OF SKELP

Canada's Alberta Phoenix Tube and Pipe Ltd. is claimed to be the newest, most modern, automated steel pipe mill in the Western Hemisphere. It will produce approximately 150,000 tons of pipe a year ranging from 3½ to 16-in. O.D. No workman touches the pipe from the time it enters the line as skelp until it is loaded onto waiting flatcars in finished lengths. The big U-shaped mill line has an electronically controlled direct-current drive.

An integral and important section of this line is a Wheelabrator Cabinet for scouring clean the edges of the skelp to expose the virgin metal to facilitate welding. Depending on gage, the automatic resistance welder handles pipe from 30 to 80 fpm. The Wheelabrator unit has proved capable of maintaining whatever cleaning pace is required. With the entire line electronically controlled, dependability of each component is necessary to avoid excessive downtime.

The Wheelabrator mechanical descaling equipment, now being used to clean pipe skelp edges, serves to underline the versatility this process holds for the steel industry and show the high degree of control that can be achieved.



Write for details on mechanical descaling by Wheelabrator

WHEELABRATOR
CORPORATION
396 South Byrkit St., Mishawaka, Indiana
WORLD'S LARGEST MANUFACTURER OF AIRLESS BLAST CLEANING EQUIPMENT

TRABON
CENTRALIZED LUBRICATION

Roughest-toughest lubricating job in the world...

and why Trabon gets 60% of all this business

Nothing in lubrication history can match the murderous punishment dished out by a blast furnace top. Smoke, gas, ashes, rain, snow, ice and infernal heat – all these are the normal, daily obstacles that face an automatic lubricating system protecting the blast furnace tops of the nation!

And what automatic centralized lubricating system is the first choice of The "Big 6" steel producers for this crucial lubricating job? Trabon, by an overwhelming majority of installations!

Here are the facts! Of the 146 blast furnaces with centralized lubrication operated by the "Big 6" steel producers, 88 (60%) are protected by Trabon. Other steel producers boost the total of Trabon-equipped blast furnaces to over 100 not including many more Canadian installations.

Among Trabon-equipped blast furnaces is "Hazel" of the Fairless Works, U. S. Steel Corporation. "Hazel" recently set a monthly production record of 62,370 tons. Close-up shows Trabon feeders and lubricant lines which deliver the proper amount of lubricant to a typical blast furnace top.

Trabon automatically delivers a measured amount of lubricant to revolving distributors, skip sheaves, bell beams and sheaves and to other points where proper lubrication assures trouble-free operation. No bearings are ever missed. Trabon saves labor, lubricant, increases production time and eliminates the hazards of having a man with a grease gun climbing around dangerous areas.

Remember – a system that can keep a blast furnace properly lubricated can do the same for any equipment, under any conditions. Write for technical details today!

Trabon

Trabon Engineering Corporation

28785 Aurora Road • Solon, Ohio

Centralized OIL AND GREASE SYSTEMS *Monoflo* CIRCULATING OIL SYSTEMS

Equipment News...

PROGRAMMER

▲ A new static programmer which automatically adjusts electrostatic precipitator voltage for maximum cleaning of smokestack discharges has been announced by the General Electric Co.'s Industry Control Dept. It has no moving parts and can be applied to existing precipitators as well as to new installations.

Built-in flexibility of the programmer makes it adaptable to a wide variety of precipitator control circuits. General Electric engineers say it is designed for simplified installation and reduced maintenance. The use of potted transistors, rectifiers and other static components contributes to a longer operating life for the programmer.

It is equipped with a spark frequency adjustment to preset the allowable number of sparks per minute; an incremental voltage adjustment to regulate the magnitude of voltage increase or decrease in a given period of time; and a maximum current-limiting adjustment to help protect the power supply from exceeding its rating and to establish the desired maximum operating level.

TRACTOR SHOVELS MOVE BULK MATERIALS AT FORD

Ford Motor Co.'s Steel Division estimate savings at $59,000 per year over old handling methods for loading 255,000 tons of iron ore and limestone for the open hearths, plus loading slag from foundry to refuse dump. Formerly all this material was loaded into dump trucks with 1½-yard clamshells. But time-and-motion studies, made during a ten-day demonstration, proved the tractor shovel loaded faster: 20-yard trucks in 6 or 7 passes (2½ to 3 min); 12-yard trucks in 3 passes (1½ to 2 min). With its interchangeable 5-cu-yd bucket, it also loaded 20 yd of coal or coke in only 3 passes. Thus it saved truck time and loader time, and because of its lower purchase price, maintenance and fuel needs, works at a lower hourly rate. Ford now has two of these shovels, built by Clark Equipment Co.

CYLINDERS

▲ A new line of squarehead hydraulic power cylinders, the first to be offered by the company, has been announced by Anker-Holth Division of The Wellman Engineering Co.

The cylinders are made for service at 2000 psi, or 3000 psi in nonshock installations. All cylinders are tested out at 4500 psi before delivery. They are made to JIC standards.

The line comes in bores from 1½ in. through 12 in., and is available in all mountings, standardized for interchangeability.

The cylinders are double acting and can be furnished with precision-adjustment cushions at either end or both ends, without increasing length. Piston rods are of high strength steel, ground, polished and chrome plated. Steel having 125,000 psi minimum yield strength is used for the tie rods. Cylinder barrel is cold drawn seamless steel tubing honed to 10 micro-inch finish and heads are machined from cold finished steel bar stock.

The cartridge assembly is replaceable as a complete unit or the bronze rod bushing and rod packing may be replaced separately. "V" type, spring preloaded rod packing is available in stock sizes and materials to suit all types of fluids. The rod wiper provided is interchangeable with standard metallic scrapers.

GAS TURBINE

▲ A new 3250-hp gas turbine used as a mechanical drive for pumps, compressors or generators has been added to the family of available gas turbines rated at 5000, 8000, and 12,000 hp by the Westinghouse Electric Corp.

The simple open-cycle gas turbine operates at 8500 rpm and any output speed can be obtained through the use of gearing. A quick starting feature permits the gas turbine power plant to reach operating speed in less than three minutes.

At full load, the exhaust flow is approximately 191,000 lb per hour at 775 F. This relatively high exhaust temperature can be used to produce low-pressure steam with a waste heat boiler or a heat exchanger located in the exhaust duct.

The gas turbine is 21 ft long, 6 ft wide and 4½ ft high and weighs only 14,000 lb. The small size and weight permits installation in a limited area at a minimum of cost in foundation and building.

Mounted on a common bedplate, the unitized structure consists of gas turbine, driven apparatus, starting equipment auxiliaries and controls. This type construction keeps installation costs to a minimum because all integral piping and controls

IMPULSE RUNNER

DURALOY

It's a 7 ton 18-8 Casting designed to handle acidulous water

With our battery of large electric furnaces and our large modern well equipped molding department, castings of this size are quite common in our production schedule.

Yet, if you require it, we can produce castings as light as only a few ounces. In fact, with our shell molding department we can produce in quantity very small pieces of any high alloy analysis desired.

Experience? Well, our work with static high alloy castings goes back to 1922 and with centrifugal castings back to 1931. This long experience is your assurance of a sound casting correctly alloyed.

The DURALOY Company

OFFICE AND PLANT: Scottdale, Pa.

EASTERN OFFICE: 12 East 41st Street, New York 17, N. Y.
ATLANTA OFFICE: 76—4th Street, N.W.
CHICAGO OFFICE: 332 South Michigan Avenue
DETROIT OFFICE: 23906 Woodward Avenue, Pleasant Ridge, Mich.

are included in one assembly. Only the external utility connections are required before the plant is ready for operation. The total weight of the plant is 27,600 lb.

A minimum of operating personnel is required due to fully automatic protection and semi-automatic starting and stopping controls. The system is so arranged that it can be adapted to remote control.

The 3250-hp gas turbine incorporates the split casing and simplified two-bearing construction that result in maximum accessibility and low-maintenance costs.

ROTARY SWAGING UNIT

▲ Patented silent-running rotary swaging machines will be manufactured by Sutton Engineering Co., under license by Sir James Farmer Norton & Co., Ltd., of Manchester, England.

The new Farmer Norton machines will offer users a dependable method of reducing ends of bars and tubes, of fixing terminals to wire cable and for many other swaging

operations. They will be built in both a two-die rotary spindle type, for smaller sizes, and a four-die inverted stationary spindle type for larger work.

The silent running design is an exclusive patented feature. Only when the operator depresses the foot treadle do the striking rollers contact the hammer blocks. At all other times, the swagers run silently. In addition to noiseless idling, this feature eliminates much unnecessary wear on the striking rollers, hammer blocks, dies, etc., and thus reduces maintenance costs considerably.

Construction design is extremely

rugged for heavy duty use, with dies, hammer block and striking rollers made of specially hardened and precision ground alloy steels. The striking rollers are accurately spaced in floating cages to ensure absolute regularity of hammer blows. All models can be supplied with feeding devices.

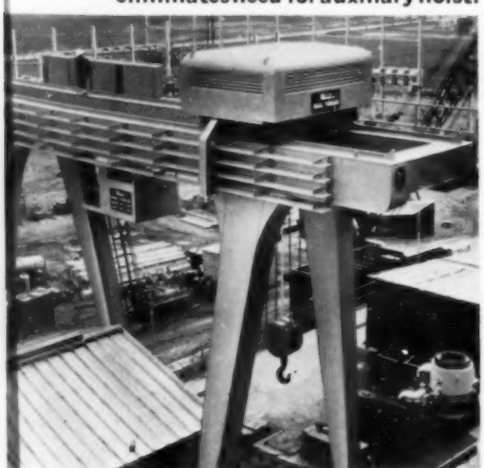
HOIST CONTROL

▲ Pacific Coast Engineering Co. has developed a new hoist control, applicable to both gantry and bridge cranes, that eliminates an auxiliary hoist. One hook provides speed with light load and power with heavy load. The hoist is called the Paceco "Dual Torque." This entirely new hoisting concept lowers first costs, reduces maintenance costs, saves operating time and increases operating efficiency.

Exclusive advantages include dual capacity and speed with one set of hoisting and electrical equipment, constant torque and speed irrespective of load on any operating point, hoisting and lowering smoothly in increments of 0.005 in. to 0.010 in., and the Paceco patented magnetic amplifier with d-c shunt motor field weakening.

The hoist applies the advantages of variable voltage and shunt field weakening to eliminate need for any auxiliary hoist and to attain high-speed operating of the main hook under light and no-load conditions. Dual Torque combines the constant speed load characteristics of the shunt motor with a 4 to 1 speed range. The design also permits hoisting and lowering in increments of 0.005 in. to 0.010 in. With the motor brake released and the motor energized, but balanced against the load at zero speed, a simple adjustment by the operator permits such accuracy without the uncertainty of brake operation and rope stretch and bounce.

Applicable for both gantry and bridge cranes, the "Dual Torque" unit eliminates need for auxiliary hoist.



GEAR PUMP

▲ A new sealed gear pump in which fluid flow is always in the same direction regardless of shaft rotation has been developed by engineers of Bijur Lubricating Corp. Featuring a compact design (2½ in. diam), this reversible pump can be mounted on any machine requiring fluid circulation for lubrication or other purposes.

Designed to be driven from a rotating machine shaft either directly or through a gear chain drive of suitable ratio, the pump is applicable to machine tools or any other machine requiring "flood lubrication" over gear trains, chains or cams. It is intended for recirculation pump systems.

It has a special lip-style seal, located on the drive shaft, which will withstand back pressures up to 20 psi. Operational failure is eliminated by the venting of pressure to the inlet of the pump by means of a pressure relief system. A built-in relief valve prevents loading the seal above rated limitations.

The pump allows reversal of drive direction while maintaining the same direction of oil flow. It is designed to be driven from a rotating shaft whose direction of drive reverses during machine operation.

A piston-type valve in the base of this pump transfers as the direction of drive reverses, keeping the direction of flow constant by connecting the proper outlet from the pump gears to the pump outlet. An exterior inlet check valve is provided to assure positive action of the reversing valve. The parts are accurately dowelled together for proper lineup.

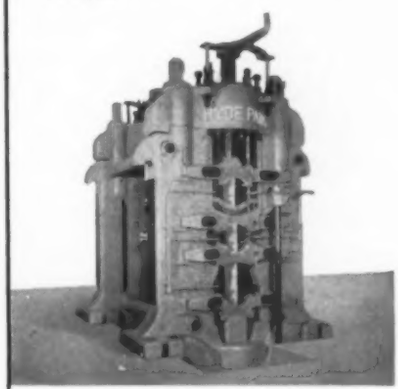
The discharge of the reversible pump is 50 cu cent. per minute at 100 rpm, and its recommended speed range is 20 to 500 rpm. Shaft seal is assembled 1/16 in. below the top surface of the pump. This pocket provides a pilot counterbore to center the drive shaft with the mating machine shaft if a tongue drive is preferred.

The pump is capable of operating

Hyde Park
RED CIRCLE Rolls ALLOY-CHILLED

Rolling Mill Equipment

For more than 50 years Hyde Park Steel Mill equipment has been helping American industry lead the world—equipment such as—



Bar Mills
Merchant Mills
Sheet and Strip Mills
Pinion Stands
Roller Tables
Reduction Drives
Stretcher Levellers
Guillotine Shears
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Roll Lathes
Special Machinery
Machine Work

For finer finish, long life and greater tonnage, specify Red Circle Rolls.

Hyde Park
FOUNDRY & MACHINE CO.
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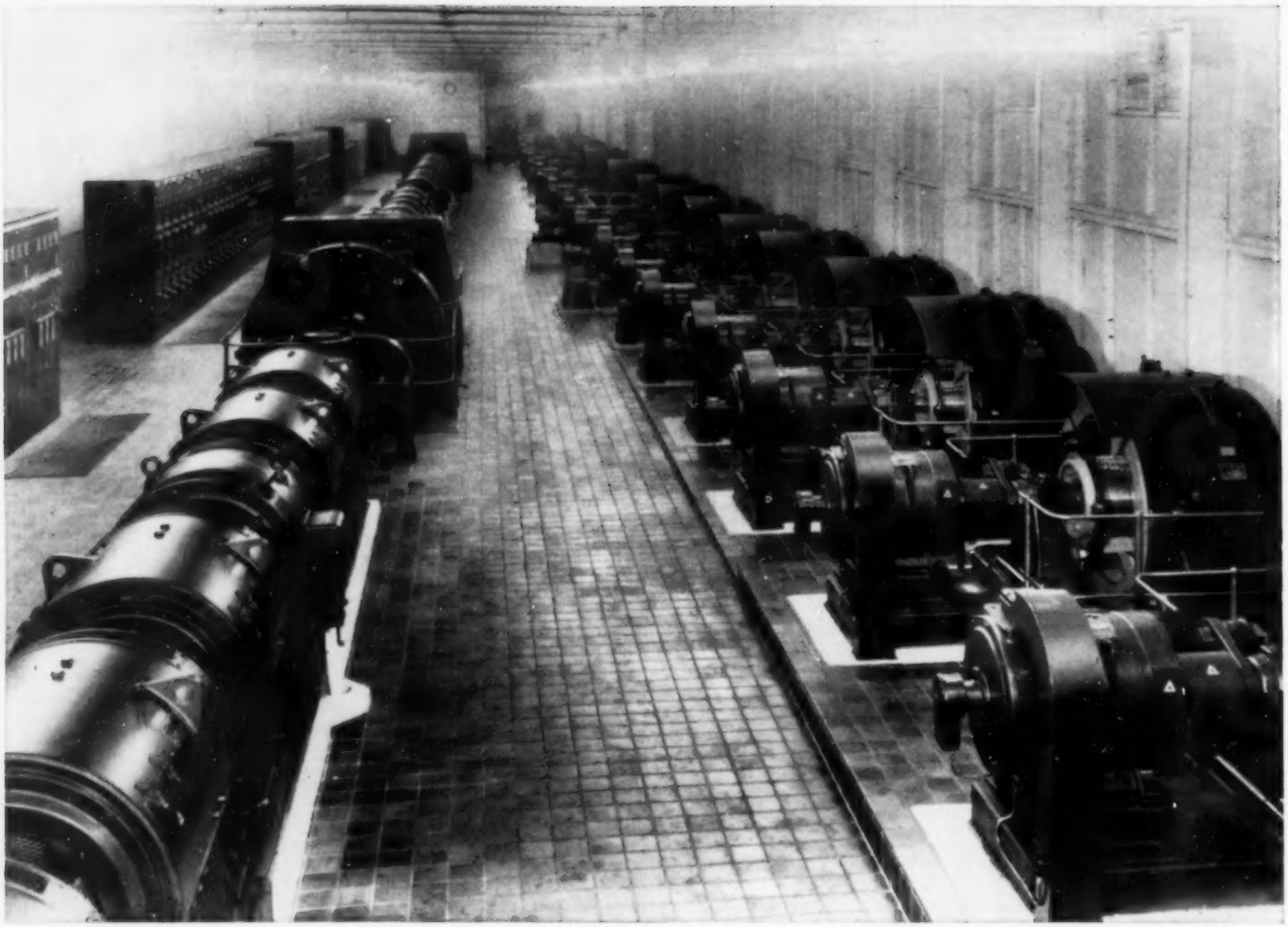
ROLLS
ROLLING MILL MACHINERY
GREY IRON CASTINGS



Photograph by courtesy of Brightside Foundry & Engineering Company Ltd.

ENGLISH ELECTRIC EQUIPS CONTINUOUS BAR MILL

This motor room for the 17 stand 11 inch continuous bar mill contains the stand drive motors totalling 8225 H.P., motor generator sets, booster sets and control gear.

The drives for the mill, flying shears, cooling beds and numerous auxiliaries, together with rectifiers and the control and distribution equipment for the high voltage and low voltage supplies, were engineered and supplied by English Electric.

If you are planning a complete steelworks electrification, or simply the addition for a small auxiliary drive, give us a call at any district office or write direct to our Metal Industries Division in St. Catharines or The English Electric Export and Trading Company Limited, Beaver Street, New York, N. Y. Our extensive experience is at your disposal.

'ENGLISH ELECTRIC' DIRECT CURRENT DRIVES

ENGLISH ELECTRIC COMPANY OF CANADA, LIMITED, ST. CATHARINES, ONT.
VANCOUVER, EDMONTON, CALGARY, WINNIPEG, TORONTO, OTTAWA, MONTREAL AND HALIFAX

PA-5773

3 ideas

for turning your outdated machine tools into money-makers

If you have boring mills, planers, lathes, grinders—machine tools of any type or size—which have lost their accuracy through hard use, Simmons *Engineered Rebuilding* guarantees to return them to the manufacturers' original specifications *at half or less than half the cost of a new machine!*

Simmons *modernizes* inefficient equipment inside out, boosts feeds and speeds through increased horsepower, new gearing and power transmission methods, automatic controls, and other up-to-the-minute features. Result: Efficient high-speed equipment for today's production. Savings, in cost, delivery time, and performance, are substantial.

Standard machine tools can be adapted to your exact needs through *conversion,* at a fraction of the price of new or special equipment. Simmons has turned old planers into accurate planer-grinders; standard lathes into special-application machines for multiple-machining jobs; outdated planers into automatic jet plane "skin" millers. *Savings to Simmons' customers: tens of thousands of dollars.*

FIND OUT TODAY *about the big savings available in rebuilding, modernization and conversion at Simmons. Write, wire or telephone: Simmons Machine Tool Corp., 1712 N. Broadway, Albany 1, N. Y.* (In NYC: 50 E. 42 St., New York 17.)

SIMMONS
MACHINE TOOL CORPORATION

SINCE 1910...Builders and rebuilders of unconditionally guaranteed machine tools

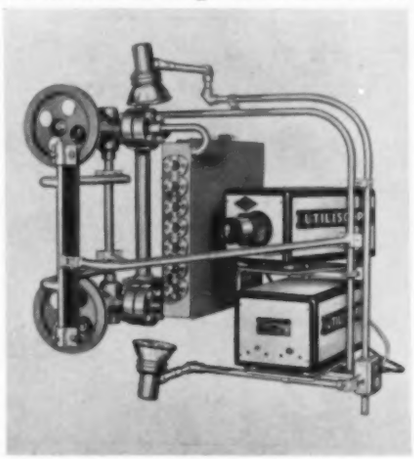
at discharge pressure of 150 psi. with approximately 80 per cent efficiency. Over-all dimensions are approximately 2½ in. diam and 1½ in. in height. It is constructed of close grained iron with steel pump gears. The drive shaft is provided with a flat for set screw. Mounting holes permit installation either on a bracket or in any position desired on the machine surface, in order to simplify over-all machine design.

Available modifications of the pump include bronze body and several drive shafts in addition to the one flatted for set screw. Among these are shafts for tongue drive, Woodruff key and other special requirements.

TV COMBINATION

▲ Announced by Diamond Power Specialty Corp., is the new Diamond "Utili-Mount"—a package combination of the Diamond "Multi-Port" or Continuous Vision Bi-Color Gage and the Diamond "Utiliscope" (Wired Television).

No engineering is needed—no installation drawings to be made—no



trouble or extra expense. The gage connections are furnished to the requirements of the drum, and the rest of the package is permanently mounted on the gage. The gage is read accurately on the television viewing screen which can be located on the boiler control panel or at any other convenient point.

It saves space and the gage is fully accessible for maintenance—the mirror assembly swings out of the way when only one cap screw is loosened. Maximum safety in event of gage leakage is provided for both personnel and "Utiliscope" camera because of the indirect viewing by mirror. Camera and mirror assembly move with the gage, so

PROGRESS IN STEELMAKING . . .

ALL-BASIC OPEN HEARTH FURNACE

Provides greater refractoriness for increased production at low cost.

This development in open hearth furnaces, which has scored impressive results both in Europe and America, marks an important step forward in the history of steelmaking. In the All-Basic Open Hearth Furnace, the roof, front and back walls, port ends, downtakes, and at least part of the checker system are all constructed of basic brick.

Properly handled, the All-Basic Furnace operates more economically than those made of silica, with equal or lower fuel costs, and with decreased overhead charges, resulting in a decrease in cost of ton per ingot.

For complete information on this important new development, write for free technical report: "The All-Basic Open Hearth Furnace."

General Refractories Company
Philadelphia 2, Pa.

GENERAL REFRACTORIES

there are no alinement difficulties or reading errors resulting from drum movement in normal expansion. Gage illuminator, frontal lights and power for camera are all integrally wired to one outlet box. The package may be compactly housed for outdoor installation.

INDUSTRIAL TRUCKS

▲ Yale Materials Handling Division, The Yale & Towne Manufacturing Co., has announced the extension of its K-48 line of medium capacity, electric powered metals handling trucks to include smaller models of 15,000 and 16,000 lb capacities.

Introduced last year in capacities from 18,000 to 30,000 lb, the lower limit of the line was extended primarily to meet increasing needs for lightweight coil handling in the nonferrous metals industry.

The new lower capacity models measure just 124 in. from rear of counterweight to the face of the fork carriage and 61 in. in width.

Yale K-48 trucks are equipped with hydraulic wheel brakes for safe, positive stopping of the truck. External adjustment of the brake system facilitates maintenance on the units.

The truck can be powered with a battery or a diesel or gasoline engine generator power plant. Steering effort is considerably reduced in the K-48 through hydraulic power steer.

In addition to the hydraulic wheel brakes on the Yale K-48, the motor brake of the company's K-51 line of trucks in capacities of 20,000 to 100,000 lb is used as a safety feature. This brake's major function in the series is as a parking brake since it incorporates a dead man control feature of cutting the power and setting a brake on the drive motor shaft automatically when the operator leaves the truck.

Another important feature of the K-48 line is the "dead axle" in the drive unit. Drive gears completely sealed and running in oil, are mounted directly onto the wheel hubs allowing for the use of a heavy rugged axle and permitting easy wheel demounting.

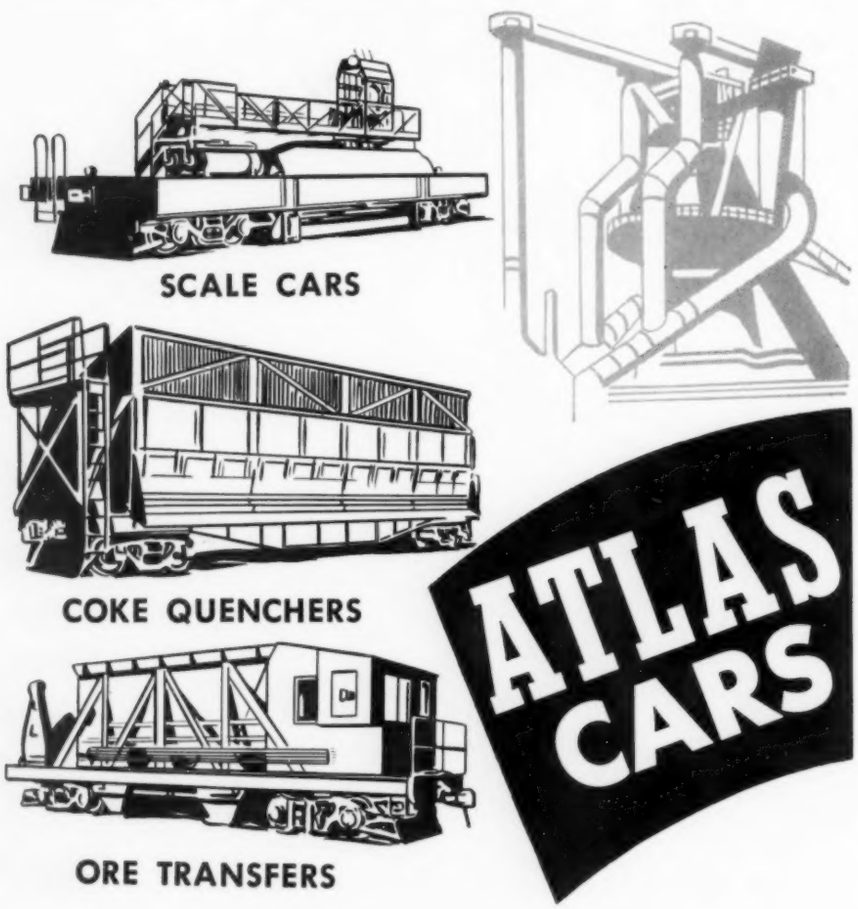
INSULATED BUS

▲ Recently announced by I-T-E Circuit Breaker Co., is a new development in bus structures. This is a 4.16, 7.2 and 13.8 kv 1200–3000 ampere non-segregated phase bus that is completely sealed with cork neoprene-gasketed split half round covers. The bus is completely insulated by air and porcelain insulators. No organic materials are used for insulation.

The design is ideally suited for generator leads to transformers, for connecting transformers to switchgear assemblies, for interconnecting switchgear assemblies, and for distribution of light and power in factories and office buildings. Other features of this new design include flexible or laminated connectors to make sections easier to install. Circular design requires less space for installation and is recommended for indoor or outdoor use.

SHAFT MOUNTED DRIVE

▲ The Falk Corp. has announced production of a completely new, larger capacity shaft mounted drive. The all steel 315J drive is available in single reduction ratio of 5:1 and in two double reduction ratios of 14:1 or 25:1. Unit ratings range from 2 hp at 5 rpm to 50 hp at 359



These cars are built to give the dependable service required for continous furnace operation. All approved modern safety devices are incorporated for extra factors of safety.

Each car is engineered to meet the operating conditions of the plant where it will be used.

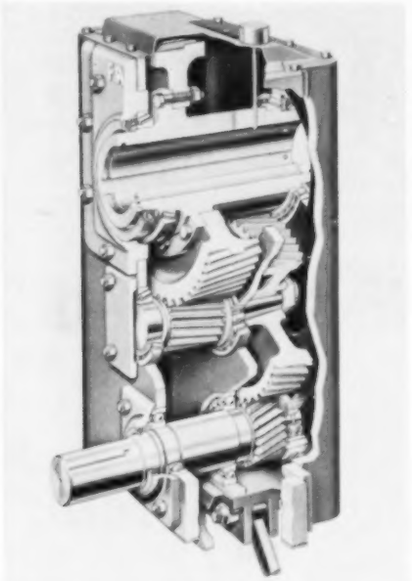
CONSULT ATLAS FOR YOUR STEEL PLANT CARS

THE ATLAS CAR & MFG. CO.

ENGINEERS MANUFACTURERS

1140 IVANHOE RD. CLEVELAND 10, OHIO, U. S. A.

rpm; maximum torque rating at low speed shaft is 31,000 lb-in. A longer center distance between shafts permits use of larger sheaves on installations where unit is mounted with input shaft toward driven machine or on through-shaft applications.



Inspection covers on the 3-wall one-piece all steel housing provide easy inspection of bearings and helical gears. An automotive type dip stick is provided for a quick check of oil level.

MANUAL AUTOSTARTER

▲ A new a-c manual nonreversing autostarter (Type JF) is available from Westinghouse Electric Corp. for starting squirrel-cage induction motors from 5 to 125 hp at 220 volts, and from 5 to 250 hp at 440/-550 volts. The unit is designed for use wherever across-the-line starting current of motors exceeds local power company restrictions or interferes with plant operations.

The JF autostarter is housed in a shallow, wall-mounted NEMA 1 general purpose enclosure but NEMA 4 watertight or NEMA 9 class 2 group G enclosures are also available. The line has five sizes, numbered 2, 3, 4, 5 and 5L, according to horsepower requirements.

The autotransformer is of the two-coil type, and is connected open delta. It meets NEMA standards permitting a cycle of one 15-second start in each four-minute interval, for a total of four starts followed by a two-hour rest period. Transformer taps provide starting voltages of 65 per cent and 85 per cent of line

WITH

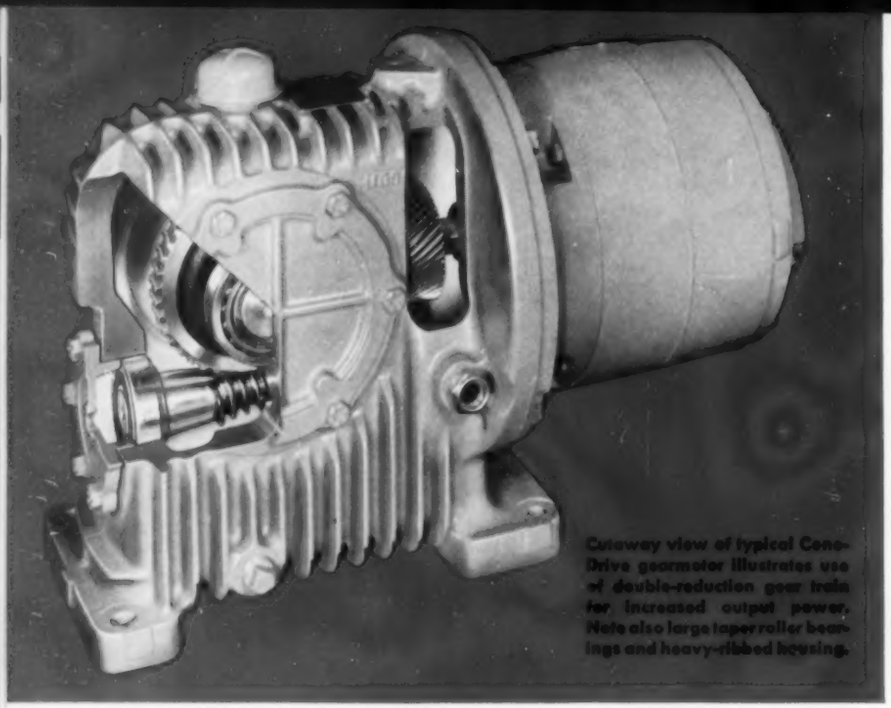
Markal Paintstik MARKERS!

PERMANENT—FADEPROOF—WEATHERPROOF

Marks remain visible under any extremes of heat up to 2100°F. or cold down to —50°F. and under any weather conditions. For marking raw materials or finished products. Markal Paintstik Marks stay on until *you* want them off.

FREE SAMPLE PAINTSTIK; STATE YOUR MARKING CONDITIONS.

MARKAL COMPANY • 3087 West Carroll Avenue • Chicago 12, Illinois



Cutaway view of typical Cone-Drive gearmotor illustrates use of double-reduction gear train for increased output power. Note also large taper roller bearings and heavy-ribbed housing.

Announcing a

POWERFUL NEW DRIVE

by

CONE-DRIVE GEARS

Here are the "why's" for this new gearmotor

Why a right-angle gearmotor?
You save space! By tucking the entire unit in close to the driven shaft, there's nothing to stick out in crowded aisles. It's out of the way.

Why a double-reduction design?
More power! Combining a helical primary with a Cone-Drive double-enveloping worm gear secondary gives you an extremely high load-carrying capacity. Output torque ratings are much higher than those of single reduction gearmotors. Overall ratios are greater, too.

Why double-enveloping worm gears?
More power! Cone-Drive double-enveloping worm gears have proven that they provide maximum load carrying capacity on extremely small center distances. This means, in many cases, that they will handle two to four times the load of cylindrical worm gears of the same size. An added plus is high resistance to shock loads, long operating life and minimum maintenance requirements.

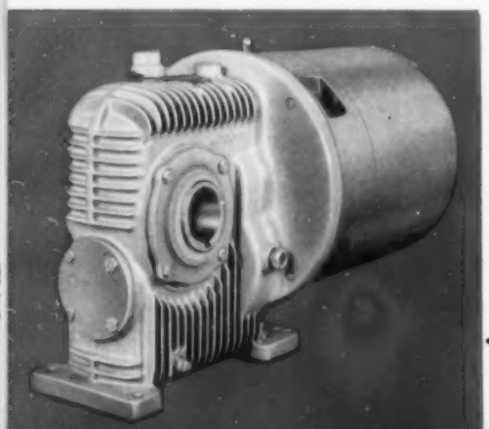
Why different types of mountings?
Flexibility! You can select Cone-Drive gearmotors with extended shaft or for shaft mounting. Both are standard. Shaft mounting often permits "hanging" the driven load on the gearmotor to eliminate pillow blocks, bearings, torque arms, shafts, pulleys, bed plates, etc. Both types may be floor, wall or ceiling mounted as desired.

Why 27 standard output speeds?
Standardization! Standard reductions range from 3.3:1 to 240:1. Speeds at 1750 rpm input range from 525 rpm to 7.3 rpm output speed. Any variation in input speed will naturally provide another complete set of 27 output speeds. Any standard type NEMA D-flange motor may be used. Other reductions may be obtained on special order at additional cost.

Why ratings to only 25 horsepower?
Demand! Extensive market research by Cone-Drive Gears reveals that this is the most popular power range in the application of gearmotors by industry. Currently we are building models in capacities from 1 to 25 horsepower. However the compact size and high capacity of the Cone-Drive gearmotor will extend this range in the future. Space requirements for higher capacities will be substantially reduced with our new design.

Why a Cone-Drive gearmotor?
Dependability! For over 20 years Cone-Drive Gears has been building double-enveloping worm gears and speed reducers. Design and manufacturing techniques have been constantly improved so that today these unique gears provide, size for size, the highest load-carrying capacity of any right angle worm gearing. Now, you can take advantage of this outstanding gearing combined into an integral package that eliminates pulleys, sheaves, belts, chain, bearings and all the trouble that goes with separate reducer and motor combinations. You'll get increased efficiency at lower cost by specifying standard Cone-Drive gearmotors.

Bulletin #57 contains complete details. Ask for it today.



◀ Here's the finest shaft mounted gearmotor on the market today. It is available in all sizes with ratings identical to other Cone-Drive gearmotors.

CONE-DRIVE GEARS
Division Michigan Tool Company
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS
7171 E. McNICHOLS ROAD • DETROIT 12, MICHIGAN

voltage; starters larger than 50 hp also have a 50 per cent tap.

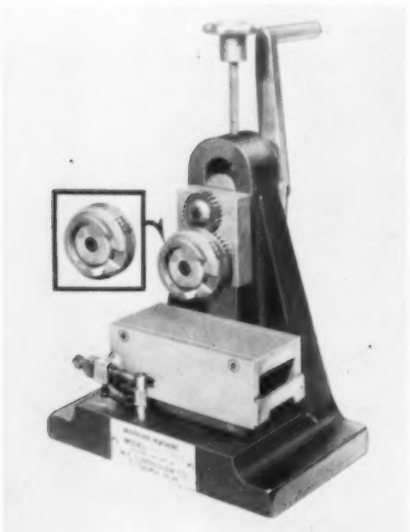
Overload protection is provided by two MW bimetallic snap-action disc-type overload relays. All starter sizes use double-break silver alloy air-break contacts. Sizes 4, 5 and 5L have De-ion® arc quenchers on the start contacts for long contact life.

A new sequence and holding mechanism, which governs the starting sequence, positively prevents going to the "run" position without passing through the "start" position first. The mechanism opens the contacts in case of overload or undervoltage. The starter is held in the "run" position by a solenoid operated latch.

Modifications available include a time-delay undervoltage protection mechanism, an L-60 electrical interlock for operating external circuits and a cover-mounted ammeter. Remote emergency stop push buttons can be added to the local stop button included with the starter.

MARKER

▲ The M. E. Cunningham Co. GRD stamping fixture has been modified to include an improved and simplified type-change feature. This will facilitate type changes during the stamping process and



will make the fixture more adaptable for use in short production runs.

The basic fixture was developed originally for stamping solid rounds and tubular products; but recent mandrel, cradle and table attachments have made it adaptable for such products as flat stampings, hex plugs, sleeves, conical pieces, long bar parts and channels.

A newly designed spring-actuated ball lock feature now allows type to be changed easily during production runs. The knurled outer ring is moved ¼ of a turn, positioning the ring opening opposite the type. The device locks in the open position while type is removed and replaced, then it is returned to the stamping position securing the type in place.

The fixture is composed of these components—steel housing and base; geared handle; marking roll; fine adjustment to control depth of lettering; as well as a table, mandrel, cradle or other assembly for holding the product being marked. As the handle is turned the marking roll rotates and marks the piece on the table or cradle.

The marking roll can be made for one or two lines of type or logotypes. Type capacity depends on size of characters to be used.

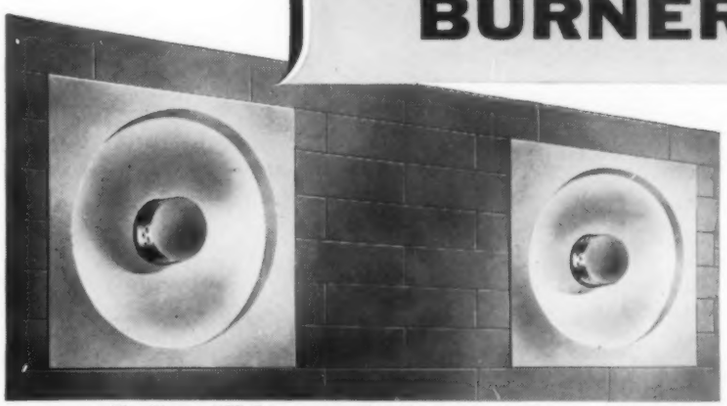
HOIST CARRIER

▲ A cab-controlled twin-hook hoist carrier provided with an auxiliary hoist for dumping has been built by the Cleveland Tramrail Division, The Cleveland Crane & Engineering Co.

Of weatherproof construction for

for intense concentration of heat...

The BLOOM HTR BURNER



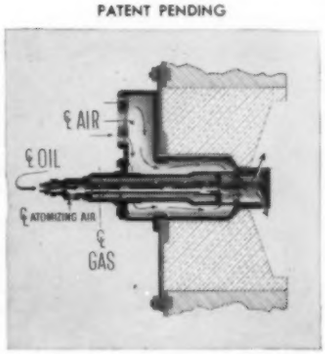
The Bloom HTR Burner provides identical operation on either gas or oil.

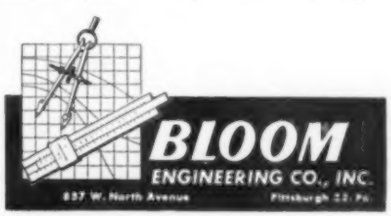
This burner enables the engineer to design a heat pattern with excellent results, because it has the unique characteristic of providing localized high heat release with low forward velocity. The burner can be located to fire directly at the material without flame impingement. Roof firing is easily accomplished and provides uniform hearth temperature.

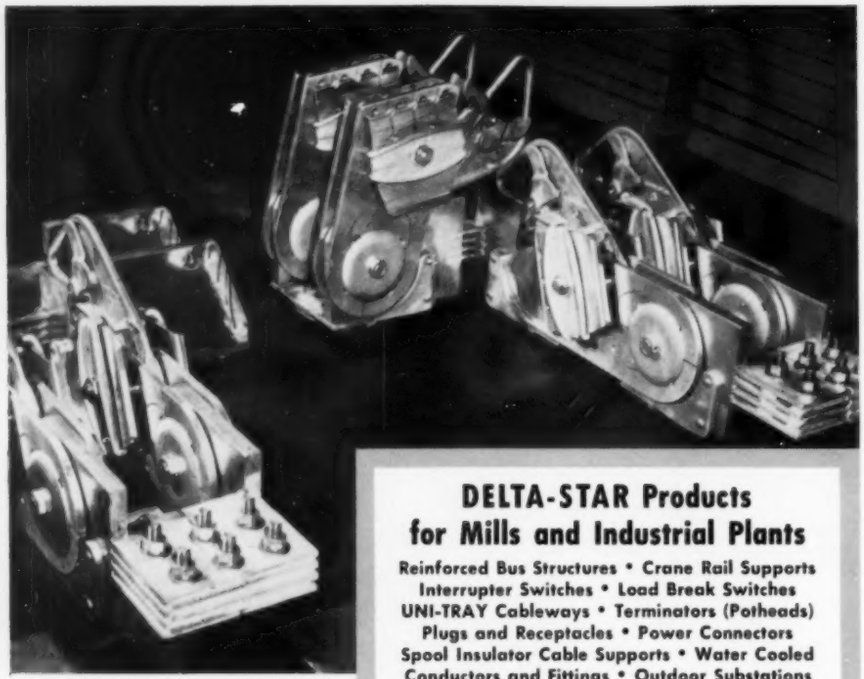
This burner has been very successful in its application to tube upset furnaces; continuous strip annealing, coating, and pre-heating lines; high speed billet heating furnaces; and batch-type forge furnaces.

The Bloom High Thermal Release Burner with its sturdy construction is ideal for applications requiring speed and precision heating.

PATENT PENDING







DELTA-STAR Products for Mills and Industrial Plants

Reinforced Bus Structures • Crane Rail Supports
Interrupter Switches • Load Break Switches
UNI-TRAY Cableways • Terminators (Potheads)
Plugs and Receptacles • Power Connectors
Spool Insulator Cable Supports • Water Cooled
Conductors and Fittings • Outdoor Substations

Meet your special power switching needs with DELTA-STAR Disconnects

What's *your* problem? If it involves electrical power switching, here's a demonstration how Delta-Star helps you. It shows how you meet exact specifications—gain long, efficient equipment service.

The special indoor disconnect switches shown above were designed specifically to solve a problem of by-passing and disconnecting heavy power loads. They are basically Delta-Star's unit-type single pole 6000 ampere, 600-volt J-14P Disconnects mounted on a common base. The special switch design also solved a limited space problem.

Delta-Star high capacity disconnect switches are built for easy, safe operation and heavy duty service. They feature an exclusive ball bearing pressure applicator, floating tongue-type, double-blade construction, with individually sprung, high pressure silvered button contacts. All current carrying parts are hard drawn copper. Straight-line current path reduces current interchange surfaces to a minimum.

Make use of Delta-Star's excellent reputation for precise engineering, quality products and special service. You get the kind of help you want when you need it.

For the best in high voltage electrical equipment, specify DELTA-STAR

H. K. PORTER COMPANY, INC.
DELTA-STAR ELECTRIC DIVISION

outdoor service, the unit will pick up tote boxes of materials, haul them and empty by tipping. While the carrier was especially designed for handling slag in a steel mill, it is suitable for a wide variety of materials such as castings, bolts, nuts and other machined parts, sand and various bulk materials.

Hoisting and travel motions are controlled by the cab operator. The

main hoist alone raises or lowers a tote box in upright position. Hoist speed is 35 fpm. Travel speed is 250 fpm. Variable speed drum controllers are provided.

Capacity is 12,000, lb i.e., 6000 lb per hook. Other carriers of different capacities can be furnished.

GUNNING SYSTEM

▲ An advanced refractory gunning system especially designed to use Permanente K/R 165 mix for tap hole repiping and the hot repair of basic open hearths, banks and bottoms is being introduced to the steel industry by Kaiser Chemical Division of Kaiser Aluminum & Chemical Corp.

The new gunning system, which has undergone extensive tests in open hearth shops, supplies tap hole linings which last two to four times longer than manually applied mixes and materially reduces furnace delay time caused by bank and bottom holes.

No batch mixing is required with the equipment. Mix can be fed continuously into the system through two hoppers which supply the unit's main reservoir. At 40 psi the system

shoots material accurately mixed with water at the rate of 200 lpm without pulsation or interruption.

In addition, the light, portable equipment can be folded to one side while fully loaded to permit clearance of the charging machine. Other design features include automatic oiling of mechanical parts, a built-in water pump which provides constant pressure, and air dryers located in the main reservoir that prevent caking of material.

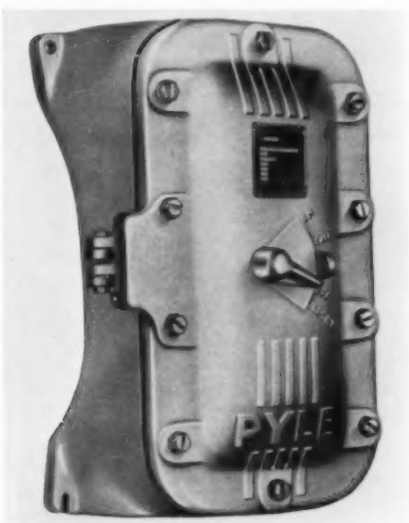
The built-in water pump eliminates the need for a bulky water tank. The amount of water added to the mix is accurately controlled by hand valve at the nozzle. When the machine is turned off, a snap valve automatically shuts off the water preventing backups which would set the mix and clog the gun.

Two types of nozzle operations may be used. A lance attachment is coupled to the nozzle for hot work on tap holes, skewbacks and banks, while for cold work, such as furnace rebuilding and repair of spouts and runners, a nozzle tip is attached.

Each unit is equipped with a sack cutter which slices sacks of mix material into 50 lb halves for easier handling when the mix is fed into the hoppers. A crew of three can feed and operate the system.

ENCLOSURES

▲ A completely new line of explosion-proof, dust-tight and weather-resistant rain-tight circuit breaker "Pylets" is announced by the Pyle-National Co. Designated the



ECB Series, enclosures are available for breaker frame sizes from 100 amp. 250 volts a-c maximum to 225 amp. 600 volts a-c maximum. Of

Keystone integrated aluminum conductor systems feature long life, minimum downtime, low installation costs, increased safety and high current capacity. Surrounding photo shows system being installed.

No winter downtime with Keystone Aluminum Conductor System

For two winters—and going into the third—Niagara Mohawk Power Company, Buffalo, has enjoyed trouble-free service with a Keystone integrated aluminum conductor system. The system replaced one of wire used with Niagara's traveling coal storage towers.

Service conditions are severe here. Ice is a big problem. Sulphuric acid fumes from coal piles cause corrosion. But with aluminum Inverted-V Keystone conductors and enclosures, these problems are solved.

Other advantages of Keystone integrated conductor systems improve operations indoors, too. Low voltage drop—rugged components—no wires to burn down. Steady operation is assured.

For further case history information and data on use of Keystone Aluminum Conductor Systems, call or write *Electric Service Works, Delta-Star Electric Division, H. K. Porter Company, Inc., Philadelphia 32, Penna.*

H. K. PORTER COMPANY, INC.

DELTA-STAR ELECTRIC DIVISION

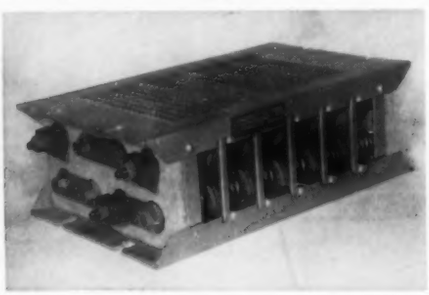
GUYAN
RESISTORS

Engineered and designed to eliminate resistor maintenance on troublesome mill applications.

Non-breakable helical coil construction ends burnouts due to warping and buckling of grids.

Sturdy, rugged steel construction eliminates shock and vibration troubles.

Custom designed for your conditions including excessive graphite accumulations.



With a quarter century of resistor engineering, we invite you to take advantage of our experience.

For complete information on Guyan Resistors, please contact the nearby Guyan Representative or our main plant at Logan, W. Va.

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Buffalo, N.Y.—Buffalo Electric Co. West Mohawk St.

Chicago, Ill.—John K. Byrne, 1515 W. Howard St.

Cleveland, Ohio—Mechanical Equipment Co., 3100 Prospect Ave.

Detroit, Mich.—Plant Equipment Co., General Motors Bldg.

Philadelphia, Pa.—George I. Wright 811 Commercial Trust Bldg.

Pittsburgh 27, Pa.—P. R. Holden, 4860 Elmwood Dr.

GUYAN MACHINERY COMPANY

LOGAN, W. VA.

the air-break type, they are suitable for use in Class I, Group D (NEMA type VII); Class II, Groups E, F, and G; and Class III (NEMA types IX, V, III) hazardous locations.

The compact, rectangular shape of the enclosure permits mounting adjacent units on extremely close vertical and horizontal mounting centers. The ferrous alloy enclosure is cadmium-plated throughout, including the flame arresting, ground surfaces of the housing-cover joint which will not, therefore, corrode or seize. A snap-in gasket for this joint is furnished to make the explosion-proof and dust-tight enclosure weather resistant as well. The single, hinged front cover gives complete access to the circuit breaker thus simplifying installation and maintenance and permitting direct wiring with a minimum of bending.

SLURRY DRUM

▲ Eriez Manufacturing Co. has announced development of a permanent magnetic drum for automatic separation of tramp iron in slurries, incorporating advanced engineering features which successfully overcome the hazard of bearing failures due to the action of liquids and abrasives in the slurry.

The drum comprises a revolving cylindrical shell enclosing a bank of stationary permanent magnetic castings occupying slightly more than 180 deg of the drum circumference. In operation, the drum is installed in a chute so designed as to direct the flow of slurry into the drum's powerful magnetic field. Any tramp iron is forced to adhere to the revolving shell until carried out of the magnetic field, when it drops into a tray. A phosphor bronze scraper bar—especially strengthened to resist any sag or wave of the edge—assists in removal of ferrous accumulations, while a waterspray near the top of the drum eliminates carry-over of slurry and abrasive material.

An epoxy resin seal has been developed for the joints between the drum shell and the end flanges, and between the drive extension and the end flange. The end flange on the stationary shaft is designed as an extension which, with its internal bearing, projects completely beyond

(*Please turn to page 252*)

COWLES
TRIMMING KNIVES

Assure more continuous production and more tonnage from each grind

Cowles knives stay on the job longer. They keep mills in continuous production with minimum downtime for knife changes. Manufactured from individually hammered forgings, and heat treated to assure maximum durability, they meet industry's most exacting requirements. Any diameter, face or bore. Widely used by all principal producers and processors. *Let us quote on your requirements!*

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Specializing in the Manufacture of

ROTARY SLITTING KNIVES • SPACING COLLARS • ROTARY TRIMMING KNIVES • ROLL TURNING TOOLS • EDGING ROLLS • CUT-OFF KNIVES STANDARD AND SPECIALLY ENGINEERED TOOLS FOR ALL FERROUS AND NON-FERROUS PROCESSING, TRIMMING AND FORMING REQUIREMENTS.

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Precision 2-High 4-High combination rolling mills, slitters and roller levelers

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LOngacre 1-7168

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for large ore crushing, screening and sintering operation in Great Lakes district. Should have heavy operating and maintenance experience. Salary open. Reply to Box 901, Iron & Steel Engineer, 1010 Empire Building, Pittsburgh, 22, Pa.

Equipment News

(Continued from page 250)

the side of the slurry chute through an opening sealed with a neoprene gasket.

Book Reviews

"The Making, Shaping and Treating of Steel," the most complete one-volume reference work relating to the iron and steel industry, was recently published in its seventh edition by United States Steel Corp.

Completely revised since its sixth edition was issued in 1951, the new volume offers users and makers of steel a comprehensive summary of present-day theory and practice covering all phases of iron and steel production from raw materials to finished products.

The new edition is the result of team effort by nearly 200 technical representatives of U. S. Steel, its operating divisions and subsidiaries, coordinated by H. E. McGannon, technical editor, under the direction of Dr. E. C. Bain, assistant executive vice president, operations.

Since 1920, over 100,000 copies of "The Making, Shaping and Treating of Steel" have been distributed to steel users, steel-plant employees, trainees, educators, students, historians, librarians, and others, on a nonprofit basis. Of the sixth edition alone, some 25,000 copies have been purchased. The book has grown in content and stature as the field of ferrous metallurgy has expanded in scope and complexity.

Recent developments in steelmaking and processing that are reviewed include the methods and equipment used in extrusion and advances in pneumatic steelmaking processes. Steel scrap is the subject of a new section of the volume, and an expanded history of the early beginnings of ferrous metallurgy is presented.

The book, which contains 932 pages of text, 773 illustrations and 126 tables, is divided into 50 chapters, which are subdivided into sections. Each chapter and section is made as nearly independent of others as possible. An extensive index simplifies use of the book for reference work.

Starting with a presentation of some of the fundamental principles of chemistry and physics, the book deals with refractories; iron ores; fluxes and slag; addition agents; steel scrap; early iron and steelmaking methods; modern blast furnace practices; the modern pneumatic, open hearth, electric furnace, duplex and triplex steelmaking processes; steel and iron castings, including roll manufacture; heating methods; rolling mills; rolling and forging practices; steel conditioning; protective coatings; heat treatment; mechanical testing; and gages.

Extensive discussions are devoted to the manufacture and properties of carbon and alloy steels, and the products made from them. These include blooms, slabs and billets; rails and structural sections; plates, merchant bars, and hot strip mill products; cold reduction mill products; galvanized products; tin plate and terne plate; circular shapes; axles; shafts; wire; tubular products; electrical sheets; and corrosion-resistant and heat-resistant products.

Copies of the volume, priced at $7.50 each, may be obtained from United States Steel, Office Service-Stores, 525 William Penn Place, Pittsburgh 30, Pa. Students of accredited educational institutions may obtain the book for $5 per copy, providing each order is countersigned by a faculty member.

Are your chances against cancer any better today?

The answer's yes . . . IF!

Formerly, we could cure one out of every 4 cancer patients. Today, it's one out of 3. So . . . why the big IF? Because the odds against cancer depend on you! Only *you* can keep alert for any of the 7 danger signals, and see your doctor about even the tiniest "maybe." Only *you* can give us the money we need to keep research going full speed. Remember, time is *everything* with cancer. So don't wait! See your doctor for a health checkup. And send a check to the American Cancer Society–today! Send your gift to "Cancer" in care of your local Post Office.

American Cancer Society

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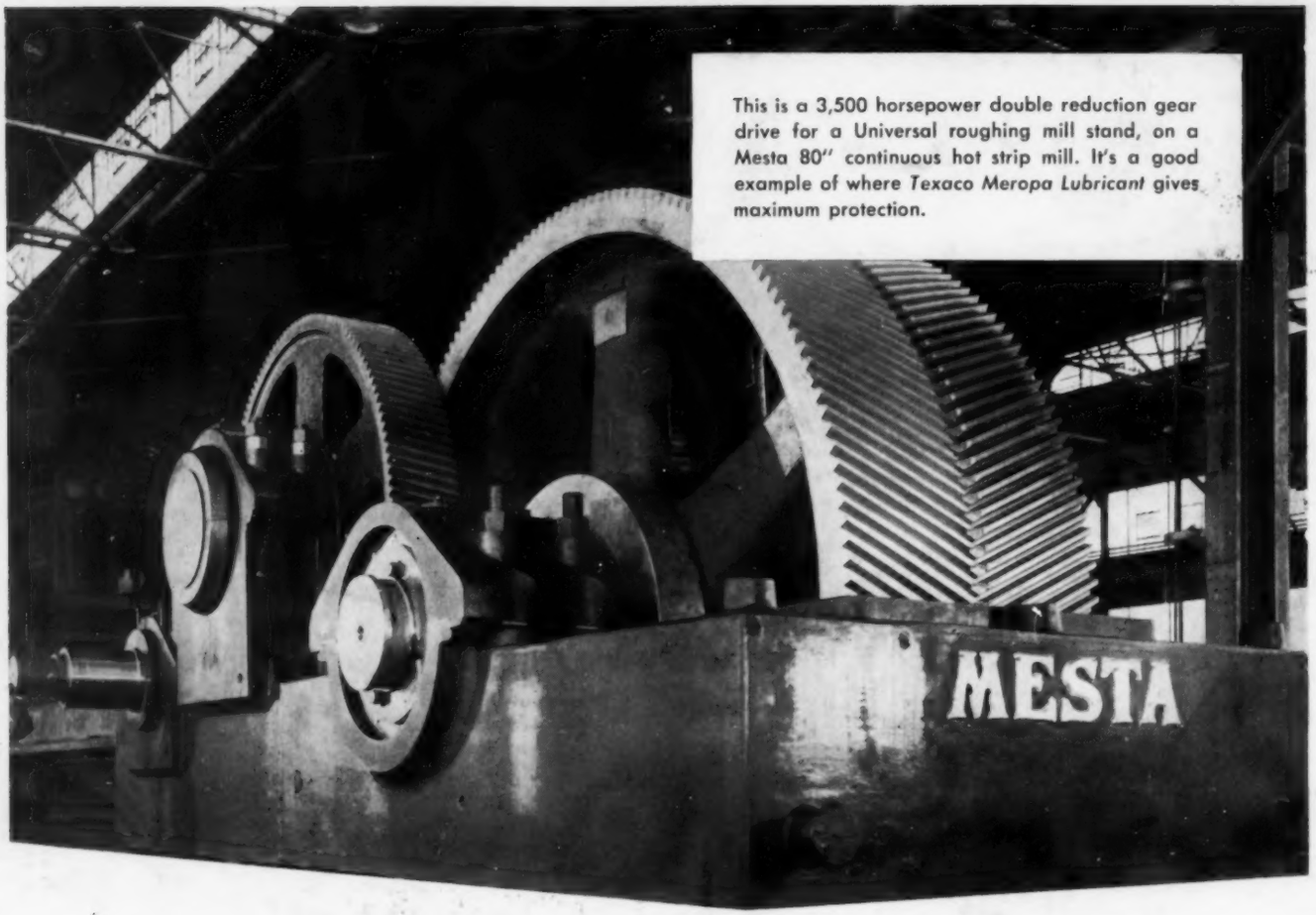

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